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Remedial Investigation/Feasibility Study of the Soldier Creek/IWTP Groundwater Operable Unit at Tinker Air Force Base

Data Quality Objective Plan

Final

Prepared for

Oklahoma City Air Logistics Center

Tinker Air Force Base, Oklahoma

May 1994

AU405

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Prepared by

Engineering-Science, Inc.
Austin, Texas

May 1994

USAF Contract Number F34650-93-D-0106
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FIGURES

TABLES

LIST OF ACRONYMS

AA	Atomic absorption
AFB	Air Force Base
Ag	Silver
ARAR	Applicable or Relevant and Appropriate Requirements
As	Arsenic
AST	Air stripping tower
ATSDR	Agency for Toxic Substances and Disease Registry
AOC	Areas of concern
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
Ba	Barium
Be	Beryllium
BNA	Base/neutral/acid extractables
BTEX	Benzene, toluene, ethyl benzene, xylenes
BTU	British thermal unit
Ca	Calcium
CDC	Center for Disease Control
Cd	Cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
CLP	Contract Laboratory Program
COD	Carbon oxygen demand
CO_3	Carbonate
Cr	Chromium
CRDL	Contract Required Detection Limits (EPA)
CRP	Community Relations Plan
Cu	Copper
DCE	1,2-dichloroethene
DQO	Data Quality Objective
DQOP	DQO Plan
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ES	Engineering-Science, Inc.
ESP	Environmentalist's Sub-soil Probe
FAA	Flame atomic absorption
FFA	Federal Facility Agreement
FOC	Fractional organic carbon
FS	Feasibility study
FSP	Field Sampling Plan
GAC	Granular active carbon
GC/MS	Gas Chromatograph/Mass Spectrograph
HCO_3	Bicarbonate

Hg	Mercury
HQ	Headquarters
HSL	Hazardous Substance List
HSP	Health and Safety Plan
IDW	Investigation derived waste
IRP	Installation Restoration Program
IRPIMS	IRP Information Management System
IWTP	Industrial wastewater treatment plant
K	Potassium
LOD	Level of detection
LSZ	Lower saturated zone
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mg/kg	Milligram per kilogram
MTV	Mobility, toxicity, and volume
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
Ni	Nickel
NO_3	Nitrate
NPL	National Priorities List
OC-ALC/EMR	Oklahoma City - Air Logistic Center/Environmental Management Directorate, Restoration Branch
ODEQ	Oklahoma Department of Environmental Quality
OGS	Oklahoma Geological Survey
OSDH	Oklahoma State Department of Health
OSHA	Occupational Safety and Health Administration
OW	Observation well
P&T	Pump and treat
PARCC	Precision, Accuracy, Representativeness, Completeness, Comparability
Pb	Lead
PC	Percent completeness
PCB	Polychlorinated biphenyls
PCE	Tetrachloroethene
PID	Photoionization detector
ppb	Parts per billion
PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RAS	Routine analytical service
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RFA	RCRA facility assessment
RFI	RCRA facility investigation
RI	Remedial Investigation
RPD	Relative percent difference
RPM	Remedial Project Manager
SA	Concentration of spike added to the sample
SAP	Sampling and Analysis Plan, including FSP and QAPP
Sb	Antimony
SCGW	Soldier Creek/IWTP Groundwater Operable Unit

SDWA	Safe Drinking Water Act
Se	Selenium
SO_4	Sulfate
SOP	Standard operating procedures
SOW	Statement of Work
SR	Measured concentration in unspiked sample
SRM	Standard Reference Materials
SSR	Measured concentration in spiked sample
SV	Semivolatile
TAFB	Tinker Air Force Base
TAL	Target Analytical List (priority metals)
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity characteristic leaching procedure
TDS	Total dissolved solids
TIC	Tentatively Identified Compounds
Tl	Thallium
TOB	Tinker Off-Base
TOC	Total organic carbon
TRC	Technical Review Committee
TSCA	Toxic Substances Control Act
TSS	Total suspended solids
μg/L	micrograms per liter
USACE	U.S. Army Corp of Engineers
USAF	U.S. Air Force
USGS	U.S. Geological Survey
USZ	Upper saturated zone
VOA	Volatile Organic Analyses
VOC	Volatile Organic Compounds
WHTU	Wellhead treatment unit
WP	Work Plan
Zn	Zinc

SECTION 1

INTRODUCTION

Data quality objectives (DQOs) are qualitative and quantitative statements specified to ensure that data of known and appropriate quality are obtained during remedial response activities. To ensure that the data generated during the remedial response activities are adequate to support Tinker Air Force Base (AFB) decisions, a clear definition of the objectives and the method by which decisions will be made must be established early in the project planning process. These determinations are facilitated through the development of DQOs.

DQOs are specified for each data collection activity associated with a remedial response. The majority of data collection activities will be undertaken during the remedial investigation (RI) and additional data needs may be identified during the feasibility study (FS).

The intent of this document is to develop DQOs into RI/FS planning activities of the Soldier Creek/IWTP Groundwater (SCGW) Operable Unit. By definition (EPA 1988, 1990), an operable unit (OU) is a portion of an overall response action that by itself eliminates or mitigates a release, a threat of release, or an exposure pathway. An OU may reflect the final remediation of a defined portion of a site. Thus, this project focuses on the remediation of possible contamination in groundwater emanating from the base industrial wastewater treatment plant (IWTP) and Building 3001. This document presents the complete process of scoping the work. Data needs and sampling and analysis options are included in this DQOP. These options may or may not be selected in the project work plan. Detailed guidance on RI/FS activities can be found in the U.S. Environmental Protection Agency (EPA) documents:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/500/G-89/004, October 1988
- *Data Quality Objectives for Remedial Response Activities - Development Process*, EPA/540/G-87/003, March 1987
- *Data Quality Objectives for Remedial Response Activity, Example Scenario: RI/FS Activities at a Site with Contaminated Soils and Groundwater*, EPA/540/G-87/004, March 1987.

This SCGW DQO Plan (DQOP) is modeled after the third document.

1.1 DQO STAGES

DQOs are developed using the following three-stage process (EPA, 1987a):

- Stage 1 - Identify decision types
- Stage 2 - Identify data uses and needs
- Stage 3 - Design data collection program.

These stages should be undertaken in an interactive and iterative manner whereby all the elements of the DQO process are continually reviewed and applied during execution of data collection activities. As such, DQOs are developed at the onset of a project and revised or expanded as needed based upon the results of each data collection activity. During the implementation of the DQO process, these stages occur in a natural progression and flow together without a formal stage delineation.

1.2 RELATIONSHIP OF DQOs TO RI/FS EXECUTION

The overall objective of the RI is to determine the nature and extent of the threat posed by the release of hazardous substances and to evaluate proposed remedial alternatives. The ultimate goal of the FS is to select the most cost-effective remedial alternative which mitigates threats to and provides protection of public health, welfare, and the environment, consistent with the National Contingency Plan (NCP) of 1990 (EPA, 1990).

Phasing of RI/FS projects is undertaken to accommodate this iterative process. By separating the RI into distinct phases, data can be collected and evaluated sequentially with refinement and/or redefinition of data collection needs at the completion of each phase. The DQO process is applied during the RI/FS scoping and following each data collection activity. Through the application of the DQO process, decisions regarding the need for additional data can be made and subsequent data collection activities designed.

1.3 FORMAT AND PURPOSE OF DOCUMENT

This DQOP is intended to provide the process of DQO development. This document is organized in the following manner. Section 2 presents a brief summary of the RI/FS. Section 3 describes Stage 1 activities for the RI/FS scoping process. Section 4 describes DQO Stage 2 development. Section 5 describes Stage 2 and 3 RI activities. Section 6 presents a brief overview of the DQO development. Section 7 describes the reporting stage, and conclusions are presented in Section 8.

SECTION 2

SUMMARY OF DQO DEVELOPMENT

This section provides a brief summary on the overall process including: (1) identifying the objectives of the overall RI/FS and each component; (2) identifying the specific uses for which data must be collected and the data quality required for each use; and (3) developing a sampling and analytical plan to meet the RI/FS objectives in the most efficient and effective manner possible. To perform each of the above steps, the three-stage DQO development process is applied during the planning phase of the RI/FS. Figure 2.1 illustrates integration of the DQO process into the planning for the phased RI/FS.

This summary is organized according to each of the DQO stages. The detailed discussion is organized according to the RI/FS phases, showing how the DQO stages fit into the normal sequence of events for an RI/FS.

2.1 STAGE 1 - IDENTIFY DECISION TYPES

Stage 1 of the DQO process takes place as part of RI/FS scoping. Through interaction with data users and evaluation of existing information, a conceptual model of the site is developed and objectives are set for further data collection and evaluation efforts (if needed) to meet remedial program goals. Stage 1 activities are resumed at the completion of each RI phase to evaluate new data, refine or revise the conceptual model as appropriate, and to set objectives for the subsequent phase. Stage 1 for the SCGW operable unit is discussed in detail in Section 3.

At the completion of Phase I Stage 1 activities, a conceptual model of the site was developed showing evidence of contaminated soil, sediments, and groundwater (Tinker AFB, 1993). The site location is shown on Figure 2.2. The general layout of the site is shown in Figure 2.3. Contaminants of concern include trichloroethene (TCE); dichloroethene (DCE); tetrachloroethene (PCE); benzene, toluene, ethyl benzene, and xylenes (BTEX); cadmium; chromium; nickel; and lead in groundwater and volatile organic compounds (VOCs) and metals in soil and sediment. Potential groundwater contamination may present a health threat to nearby residents who might rely on private wells for drinking water.

The RI/FS will assess the threat posed by the groundwater contamination. Existing data are insufficient to determine the extent of contamination at the site, i.e., off-base. A phased approach (Figure 2.1) has been used to first determine the

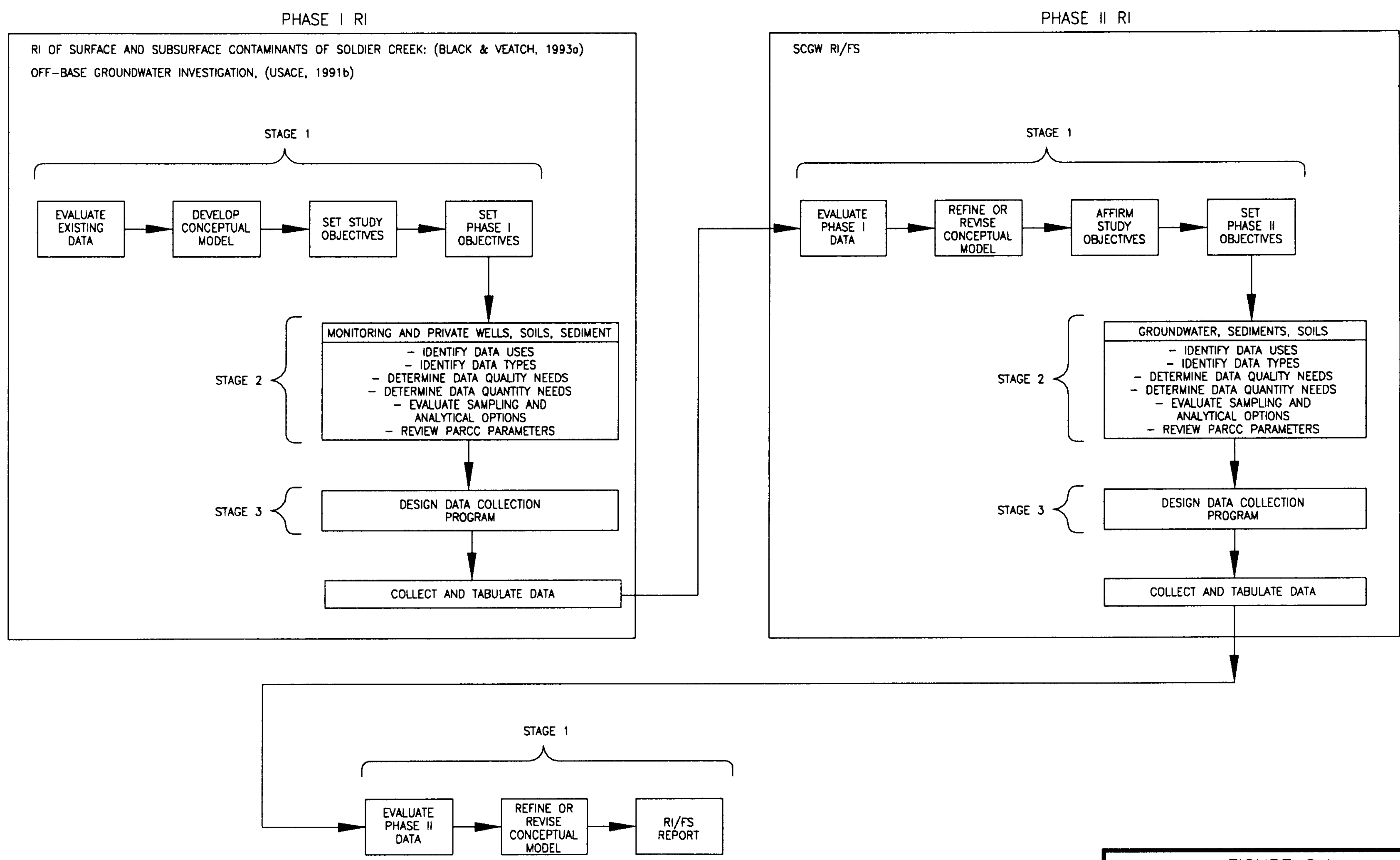
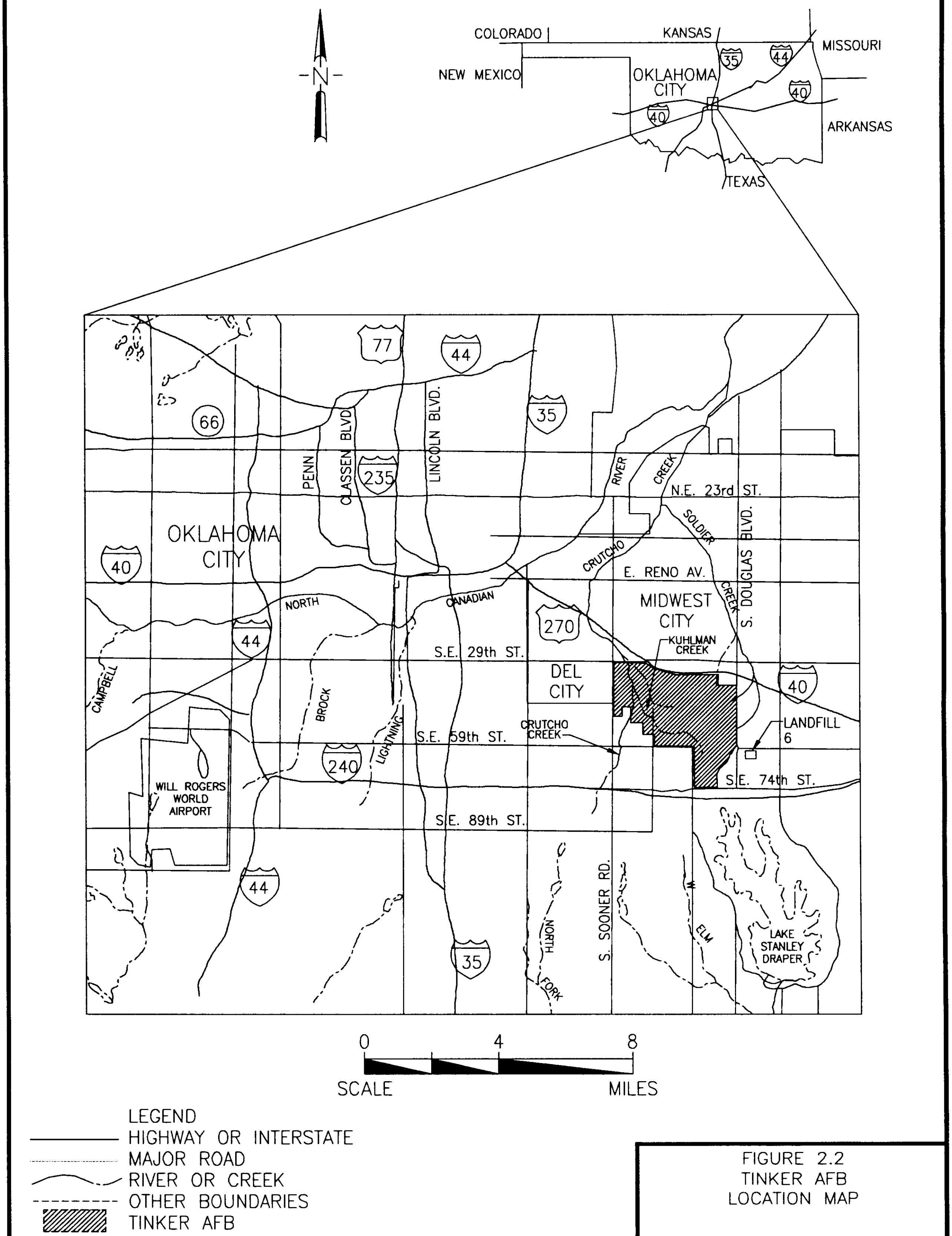


FIGURE 2.1
DQO PROCESS WITHIN PHASED WORK FLOW FOR SCGW RI/FS

TINKER AFB, OKLAHOMA

SOURCE: EPA 1987 MODIFIED

DQO 03/22/94



SOURCE: BLACK & VEATCH, 1993, MODIFIED

FIGURE 2.2
TINKER AFB
LOCATION MAP

TINKER AFB, OKLAHOMA

TINLOCHS 03/22/94

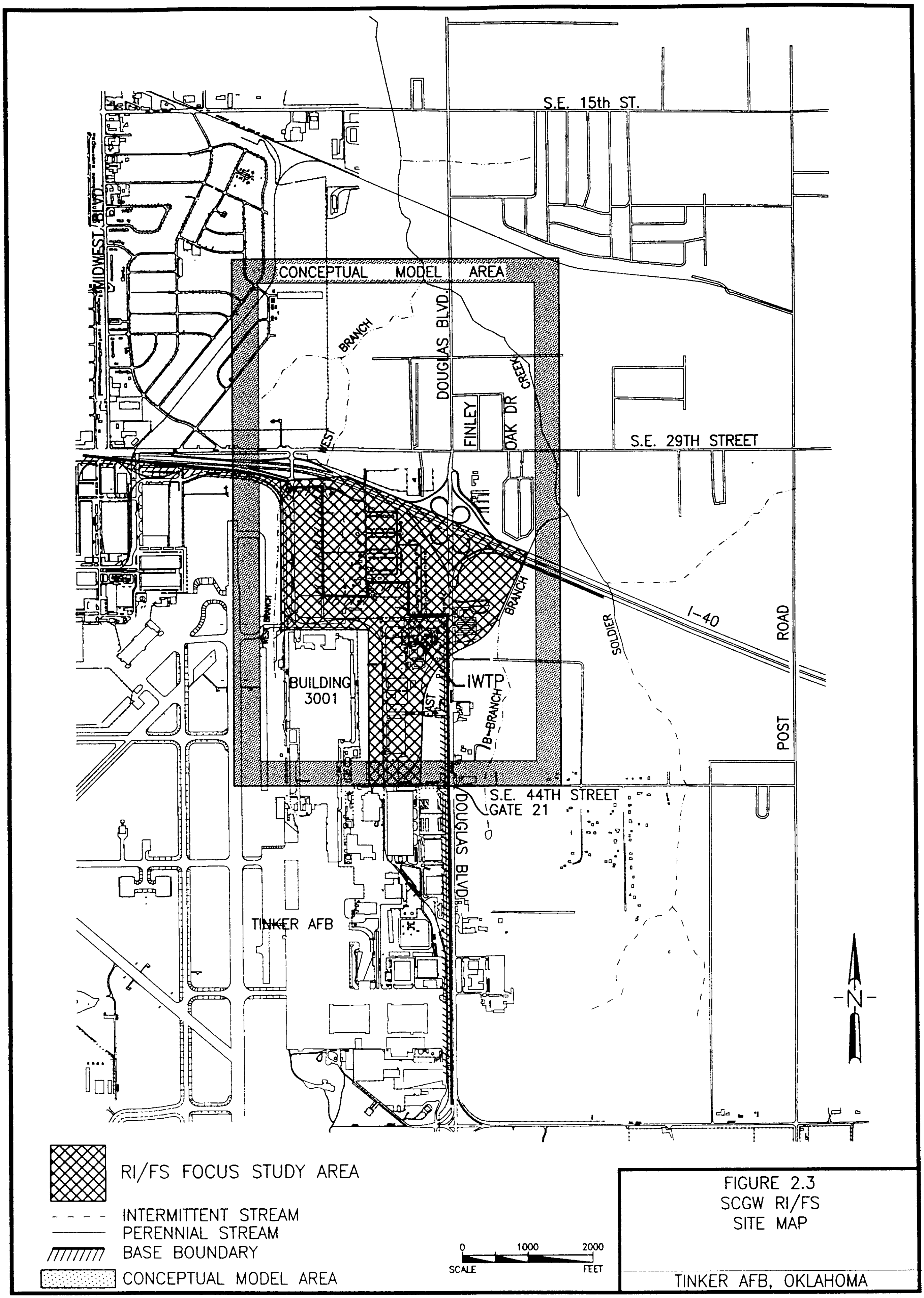


FIGURE 2.3
SCGW RI/FS
SITE MAP

TINKER AFB, OKLAHOMA

TBASELOC 5/24/94

boundaries of contaminated soil and groundwater in Phase I and then to collect more extensive data through a well-directed investigation in Phase II. Phase I entailed sampling of existing on-base wells, partial determination of the boundaries of the groundwater plume off-base through installation of off-base monitoring wells, and sampling of Soldier Creek surface water and sediment to determine the areal extent of sediment and surface water contamination. All RI activities performed before February 1993 are considered to be Phase I activities. Phase II is this SCGW RI/FS. Phase II activities will include installation and testing of additional groundwater wells off-base, sampling of surface and subsurface soils and sediments, and determination of the groundwater-Soldier Creek hydrologic interactions.

2.2 STAGE 2 - IDENTIFY DATA USES AND NEEDS

Stage 2 activities define the quality and quantity of data that will be required to meet the objectives set in Stage 1. Definition of specific uses for data and attendant data quality requirements lays the groundwork for a sound and efficient data collection program. Data are required for risk assessment, site characterization, evaluation of alternatives, and engineering design.

Table 2.1 provides a summary of the results of Stage 2 activities. Detailed discussion of Stage 2 activities is included in the following sections:

- Section 4 - Overall RI/FS
- Section 5.1 - Task 1 Historical Review and Windshield Survey
- Section 5.2 - Task 2 Inspection of Private Wells
- Section 5.3 - Task 3 Soldier Creek Streamflow Survey
- Section 5.4 - Task 4 Lithologic Coring
- Section 5.5 - Task 5 Monitoring Well Construction and Sampling
- Section 5.6 - Task 6 Conceptual Model
- Section 5.7 - Task 7 Aquifer Tests
- Section 5.8 - Task 8 Soil Sampling
- Section 5.9 - Task 9 Sediment Sampling

Task 10 of the statement of work (SOW) is chemical analysis of environmental samples by a laboratory. For project management convenience, Task 10 includes all environmental samples collected from other tasks. DQO stages for Task 10 will not be described, because the chemical analysis will be discussed in individual tasks. This report is part of Task 11 of the SCGW RI/FS.

2.3 STAGE 3 - DESIGN DATA COLLECTION PROGRAM

Stage 3 is the designing of the data collection program which includes the preparation of work plan (WP), field sampling plan (FSP), quality assurance project plan, (QAPP), health and safety plan (HSP), and community relations plan (CRP).

Table 2.1 Data Quality Summary
Tinker AFB SCGW RI/FS

Activity	Sample Private Wells (Task 2)	Soil Near Private Wells (Task 8)
Objective	Samples from existing wells will be used to determine if contaminants are present in residential wells.	Surface soil samples will be taken to assess the ingestion threat presented by lead, cadmium, nickel, chromium, arsenic, barium, copper, lead, mercury, selenium, silver, and zinc.
Prioritized data use(s)	Site characterization	Source identification
Appropriate analytical levels	Site Charac.: I, II, III	Source Identification: II, III, IV
Contaminants of concern	Priority pollutants (excluding dioxin and asbestos) and barium	EPA Target Compound List (TCL) analytes (excluding pesticides), arsenic, barium, cadmium, chromium (total and hexavalent), copper, mercury, nickel, lead, selenium, silver, and zinc
Level of concern	5 ppb TCE 50 ppb metals	450-550 mg/kg lead 90-110 mg/kg chromium
Required detection limit	2 ppb TCE	Low mg/kg range metals
Critical samples	Residential wells	

ppb = parts per billion
mg/kg = milligrams per kilogram

Table 2.1 Data Quality Summary
Tinker AFB SCGW RI/FS
(continued)

Activity	Groundwater (Task 5)	Soldier Creek Sediment (Task 9)
Objective	Groundwater data are required to evaluate the extent of contamination, develop a risk assessment, and assess potential remedial alternatives.	Sediment samples will be taken and analyzed for VOCs and metals to determine the horizontal and vertical extent of contaminants, provide input to a risk analysis, and provide information necessary to evaluate remedial alternatives.
Prioritized data use(s)	Risk assessment Evaluation of alternatives	Evaluation of alternatives Engineering Design
Appropriate analytical levels	Risk Assess: III, IV, V Eval. Alt.: II, III, IV	Eval. Alt.: II, III, IV Eng. Design: II, III, IV
Contaminants of concern	Priority pollutants (excluding dioxin and asbestos) and barium	EPA TCL analytes (excluding pesticides), arsenic, barium, cadmium, chromium, (total and hexavalent), copper, mercury, nickel, lead,selenium, silver, and zinc
Level of concern	5 ppb TCE 50 ppb metals	4 - 40 mg/kg TCE 450-550 mg/kg lead 90-110 mg/kg chromium
Required detection limit	2 ppb TCE	2 mg/kg TCE Low mg/kg range metals
Critical samples	Clean wells at study boundaries	Clean samples at boundaries of contaminated area

Table 2.2 summarizes plans for data collection activities. Based on these plans, the SCGW RI will include data collection and tabulation for the next Stage 1 process which concludes with an RI report (Figure 2.1).

Table 2.2 Data Collection Plan Summary
Tinker AFB SCGW RI/FS

Activity	Private Wells (Task 2)	Soils Near Private Wells (Task 8)
Staff requirements	Field technicians, chemist, hydrogeologist	Field technicians, chemist, hydrogeologist
Data types	Metals, VOA	Metals, VOA
Sample type	Grab	Grab, biased
Number of samples	12 private wells	48
QA/QC samples	3 matrix spike 4 duplicates 1 spike 6 trip blanks, field blanks, equipment blanks	10 replicates 3 trip blanks
Background samples	To be determined for well at study boundary	0
Sampling procedures	Private wells sampled at tap or using pump/bailer	Obtain samples at 0, 1, 2.5, and 5 feet depths
Analytical Methods/Equip. Level I field screening	pH, specific conductivity, temperature, turbidity	Photoionization detector (PID)
Level II field analysis	--	--
Level III non-CLP laboratory methods	GC/MS	AA, FAA, ICAP
Level IV CLP RAS methods	BNA, VOA, metals	Metals, VOA, BNA
Level V nonstandard methods	Method 8260/8270/7060/6010/7421/7470/7740/9010	Method 8260/8270/6010/7421/7471/7740/7060

VOA = volatile organic analyses
CLP = EPA contract laboratory program
GC/MS = gas chromatograph/mass spectrograph
RAS = routine analytical service
AA = atomic absorption
FAA = furnace atomic absorption
BNA = base/neutral/acid extractables
PID = photoionization detector
ICAP = inductively coupled plasma

SECTION 3

DQO STAGE 1 - RI/FS SCOPING PROCESS

3.1 IDENTIFY DECISION TYPES

Stage 1 of the DQO sequence is an inherent component of the RI/FS project scoping process. The elements of DQO Stage 1 are shown in Figure 3.1. Stage 1 is initiated during the RI/FS scoping process.

As the DQO (and RI/FS) process continues, the scoping of the project will become focused. Stage 1 will be initiated whenever new data are evaluated or objectives and decisions must be redefined. Subsequent to the initial RI/FS scoping process, Stage 1 of the DQO sequence is abbreviated in scope, and is focused mostly on the evaluation of newly acquired data. In cases where the field investigations have revealed a situation requiring a redefinition of the objectives, the entire Stage 1 process may have to be repeated.

Stage 1 of the DQO process is undertaken to identify the decision makers and data users and to involve them in the process of identifying the data requirements and decision types which will have to be made during the RI/FS. This section outlines the process for performance of Stage 1.

For the SCGW site, the data available from previous investigations performed by the U.S. Army Corps of Engineers (USACE) Tulsa District serve as the basis for scoping the RI/FS (USACE, 1991b). The DQO process is initiated upon receipt of a work assignment which, in this case, will be undertaken as an Air Force lead RI/FS.

3.2 IDENTIFY AND INVOLVE DATA USERS

The list of potential data users must be developed at the outset of the DQO process. The primary data users are those individuals involved in ongoing RI/FS activities. For this site, primary data users are the Tinker AFB Environmental Management (EM) Remedial Project Manager (RPM) and the contractor's (Engineering-Science, ES) site manager and staff. The site manager has the primary responsibility for incorporating DQOs into the planning and implementation activities. The RPM and the site manager will work together and be continually involved with the technical staff through the course of the project.

The initial list of decision makers and data users that will be involved in the example site are as follows:

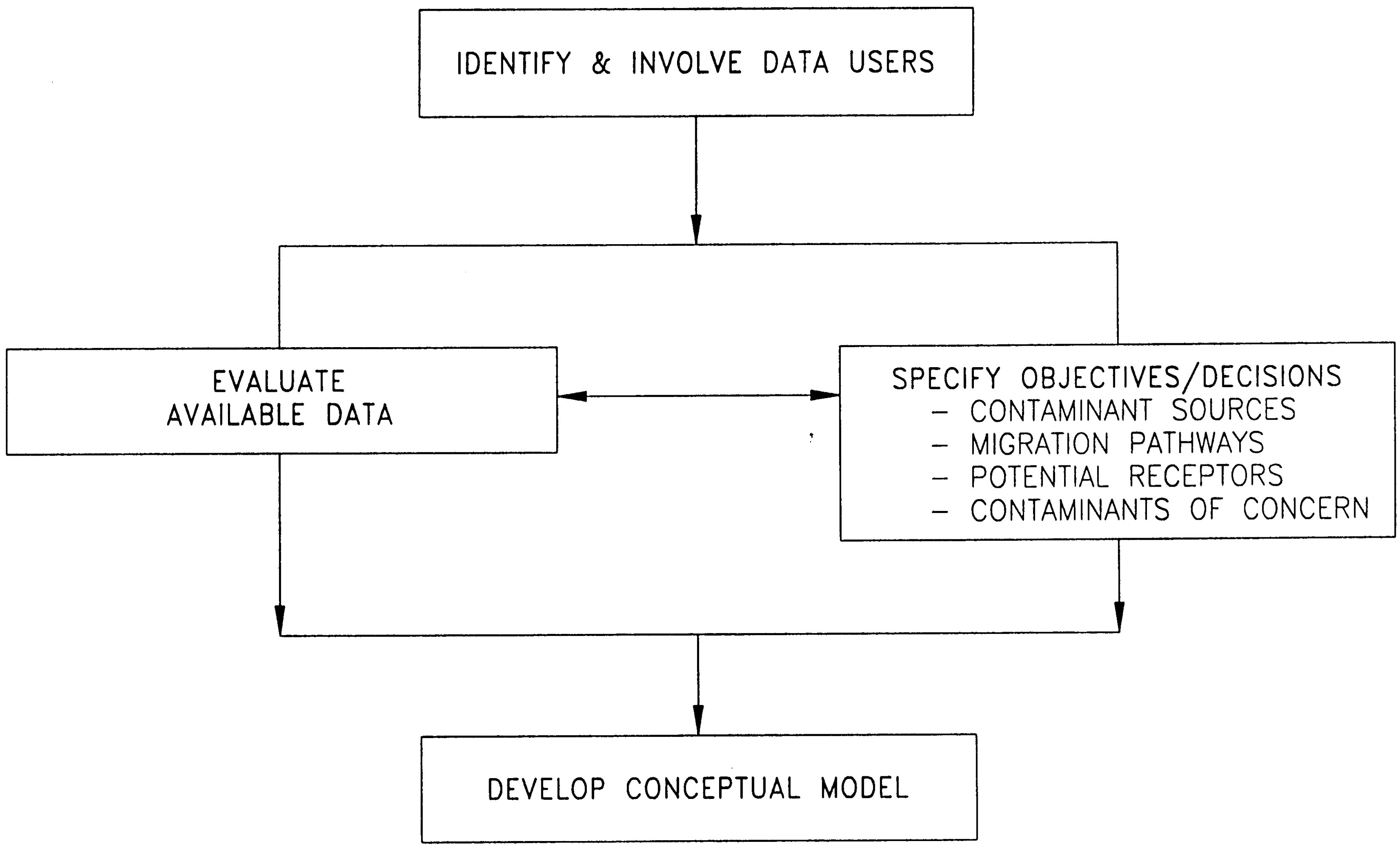


FIGURE 3.1
DQO STAGE 1 ELEMENTS

TINKER AFB, OKLAHOMA

DQO 11/23/93

- Decision Maker:
    - Tinker AFB RPM
- Primary Data Users:
    - Tinker AFB RPM
    - ES site manager
    - ES personnel (hydrogeologist, risk assessor, hydrologist, analytical chemist, environmental chemist, aquatic biologist, chemical engineer, water treatment engineer, and others).

Secondary data users include all individuals (or parties) that rely on RI/FS output to support their program activities. Secondary data users provide input to the decision maker (and primary data users) during the DQO development process through generic data needs and, on occasion, site-specific data needs. Secondary data users that may be included are listed below:

- Secondary Data Users:
    - EPA Region VI Enforcement personnel (Potentially Responsible Party determination)
    - Oklahoma State agencies personnel (remedy concurrence)
    - Agency for Toxic Substances and Disease Registry personnel (ATSDR) (health assessment).

Other groups which may be involved in the RI/FS process include the following:

- Support group:
    - Tinker AFB EM personnel (QA integrity)
    - Materials Command Headquarters (HQ) personnel
    - Research institutes such as universities, U.S. Geological Survey (USGS), and EPA laboratory.

Primary data users will review available data and identify data needs. Secondary data users are brought into the scoping process as necessary, such as through technical review committee (TRC) meetings.

3.3 EVALUATE AVAILABLE INFORMATION

In this step of the DQO process, the existing information and available data are evaluated. For this RI/FS, a reconnaissance level site visit was performed by the site manager and appropriate staff to evaluate and confirm the available data, and thus develop an objective assessment of current site conditions.

3.3.1 Describe Current Situation

The SCGW site is located in a relatively flat area with land forms created by sedimentary deposits of an ancient sea.

As part of the overall Air Force Installation Restoration Program (IRP), Tinker AFB began a preliminary assessment of previously used waste disposal sites in 1981 (ES, 1982). As a result of a basewide sampling program in 1983 which detected TCE in the groundwater, extensive investigations were conducted in and around Building 3001. These investigations identified chromium as an additional contaminant of concern in the groundwater. On July 22, 1987, the Building 3001 Site and the Soldier Creek Site were added to the National Priorities List (NPL). On December 9, 1988, EPA Region VI, the Oklahoma State Department of Health (OSDH), and Tinker AFB signed the Federal Facility Agreement (FFA) under CERCLA Section 120 to "ensure that the environmental impacts associated with past and present activities at the [Building 3001 and Soldier Creek Sites] are thoroughly investigated and appropriate remedial actions [are] taken as necessary to protect the public health, welfare, and the environment" (EPA, 1988b). The specific activities to be performed under the FFA include, but are not limited to, completion of RI/FS activities at the Soldier Creek Site (EPA, 1988b).

The Building 3001 Site and adjacent underground storage tank areas have undergone extensive investigations to determine the nature and extent of contamination in and around this complex. In addition, a risk assessment (USACE, 1988b) and an RI/FS (USACE, 1988a and 1988b) have been completed for the Building 3001 Site.

Investigation of possible sediment and surface water contamination of Soldier Creek began in 1984 (Radian, 1985). Based on the results of the investigations of Soldier Creek, a removal action was performed on on-base portions of East and West Soldier Creek in early 1986. Visibly contaminated sediments were removed and disposed in an approved hazardous waste landfill.

The Soldier Creek/IWTP Groundwater (SCGW) operable unit is the focus of this investigation. The SCGW operable unit includes the off-base groundwater under and adjacent to Soldier Creek where contamination may have originated from the Soldier Creek and Building 3001 NPL site. The media of concern for the SCGW RI/FS are groundwater and Soldier Creek sediments.

3.3.2 Review Existing Data

As part of the site investigation performed by the USACE, an off-base groundwater investigation and an RI of Soldier Creek were performed. A number of samples were obtained and submitted to the CLP-equivalent laboratory for a full scale Hazardous Substance List (HSL) compounds and metals analyses including volatile and semivolatile organic compounds, polychlorinated biphenyls (PCBs) and pesticides, cadmium, chromium (total, III, VI), nickel, and lead.

In addition, a photoionization detector (PID) was used to monitor the air for organic vapors over the entire site (USACE, 1991a). Air was not identified as a potential contaminant source or contaminant migration pathway in the off-base groundwater RI report (USACE, 1991b). The samples collected include near-surface soil samples, groundwater samples from each of the on- and off-base monitoring wells, and surface water samples from Soldier Creek upstream from Reno Avenue to the watershed divide off-base. The contaminants of concern included TCE, PCE, DCE, BTEX, cadmium, chromium, nickel, and lead in groundwater and volatile organic compounds and metals in the soils. The samples were analyzed by the CLP-equivalent laboratory using routine analytical service (RAS) analytical methods and detection limits. Only BTEX contamination was reported for the residential wells sampled by the OSDH (USACE, 1991b).

3.3.3 Assess Adequacy of Data

An essential step in the evaluation of available information is determining the reliability and applicability of the available data. The data available for the SCGW site were reviewed in terms of methods of collection and analytical techniques. The sample collection techniques were documented in the site investigation and RI reports (USACE, 1991a and b; B&V, 1993a). Based on this review, the site data are considered to be both reliable and acceptable. However, the existing data are insufficient to characterize the site in terms of the degree and extent (both horizontal and vertical) of off-base contamination and thus to support any potential remedial alternatives in the FS.

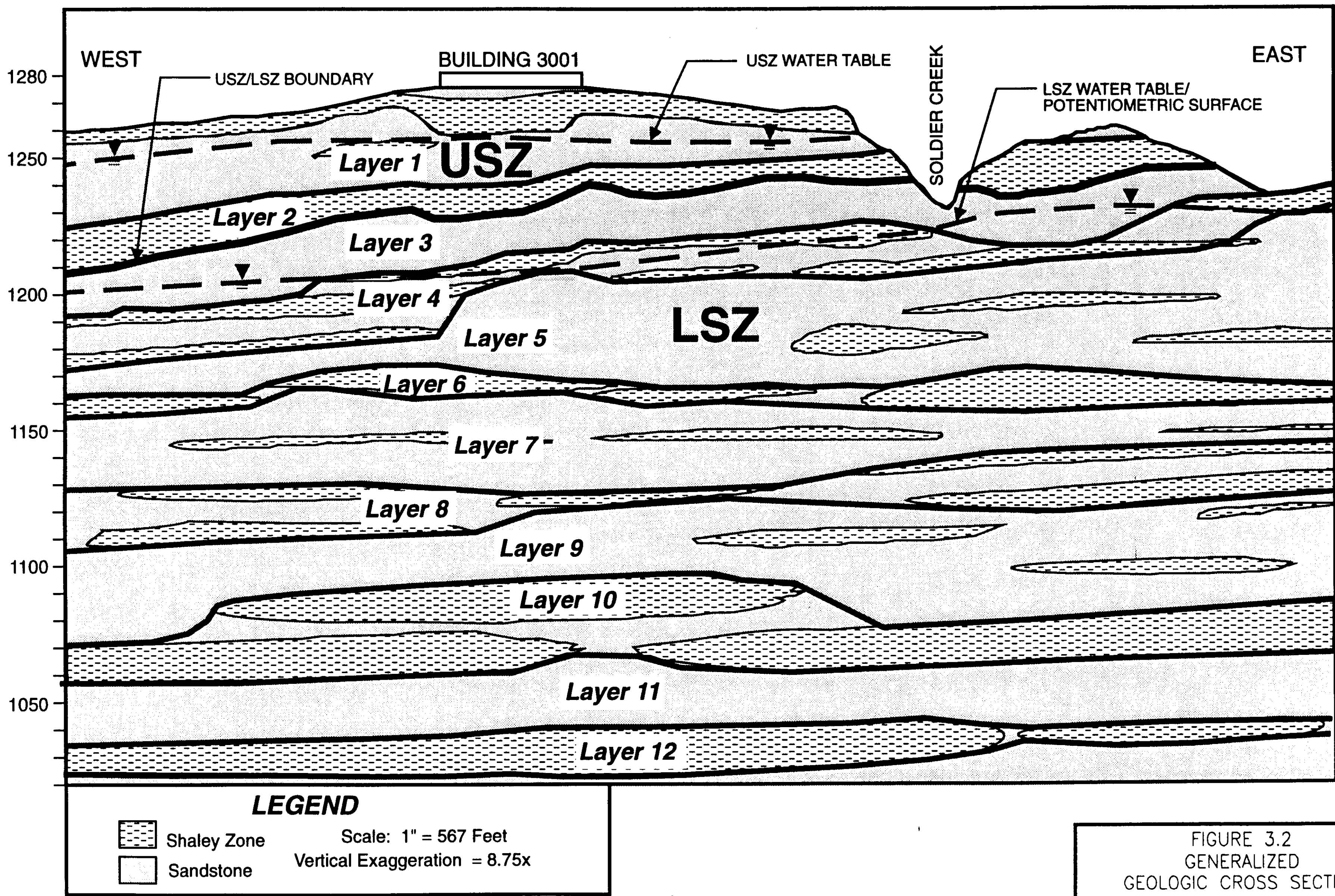
3.4 DEVELOP CONCEPTUAL SITE MODEL

Based on available information, a conceptual model was developed (Battelle, 1993; Tinker AFB, 1993) to provide an understanding of the sources of contaminants, the migration pathways of contaminants, and potential receptors. A conceptual model of the site is presented in Figures 3.2 to 3.4. The cross-section is relatively simplistic; however, if additional data collection activities identify any complex geologic features, these would be reflected in a more complex conceptual model. If necessary, a series of media-specific models could be developed to identify contaminant migration pathways.

In developing the conceptual model, all of the possible contaminant pathways must be considered. Air is not considered to be a complete contaminant pathway, because the potential for contaminant release into the atmosphere is considered minimal under day-to-day circumstances (USACE, 1991b).

Surface runoff is not considered to be a complete contaminant pathway since the on-base source areas were either remediated or covered. However, the Soldier Creek baseflow may contribute contaminants to the streamflow. The streamflow is composed of surface runoff and baseflow. The upper saturated zone (USZ or perched aquifer) may contribute baseflow to Soldier Creek. This aquifer is reported to have solvents, fuel, and metal contamination.

More information is required concerning the potential threat from direct contact with, and the potential ingestion of, Soldier Creek sediments possibly contaminated with lead, cadmium, nickel, chromium, solvents, and BTEX. The potential for direct contact with (or exposure to) organics (solvents and BTEX) has been assessed to be low since organics (detected on site) tend to volatilize rapidly from sediments (B&V, 1993b); however, the potential for direct contact with sediments contaminated with metals must be evaluated.



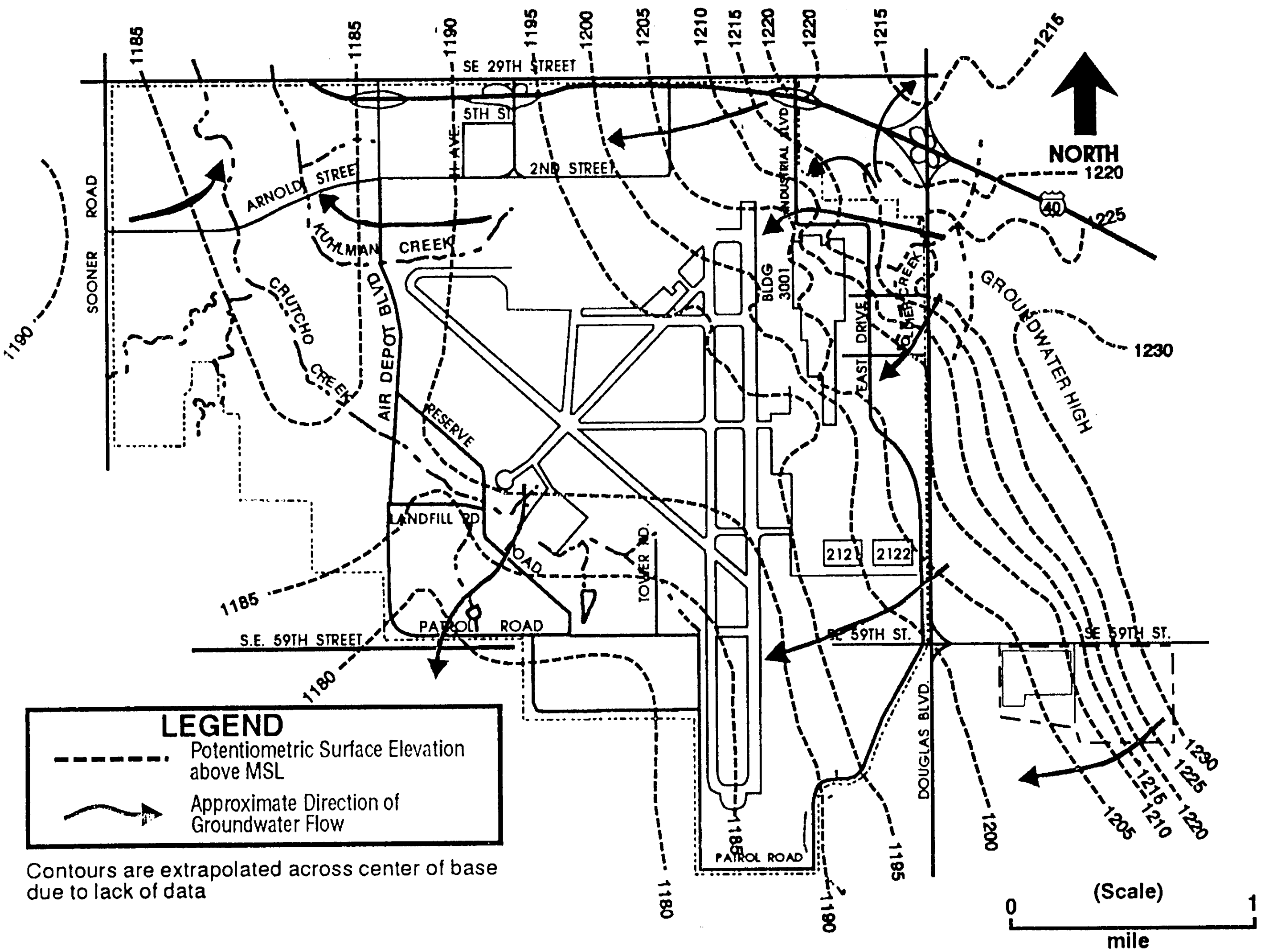
SOURCE: BATTELLE 1993

FIGURE 3.2
GENERALIZED
GEOLOGIC CROSS SECTION

TINKER AFB, OKLAHOMA

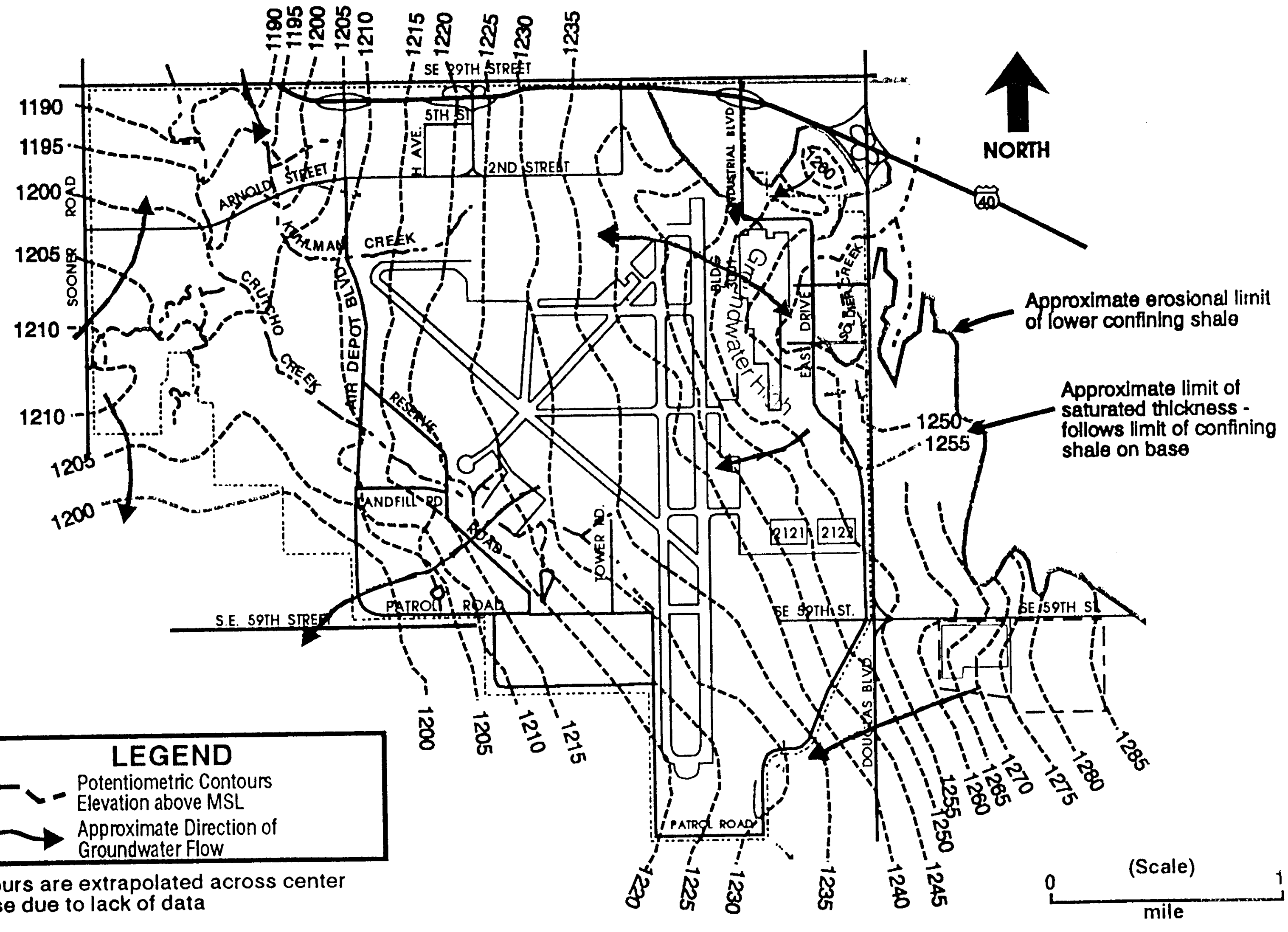
TGEOXSEC 03/25/94

FIGURE 3.3
TINKER AFB
Potentiometric Surface of Lower Saturated Zone



SOURCE: TINKER AFB, 1993

FIGURE 3.4
TINKER AFB
Water Table Surface of Upper Saturated Zone



LEGEND

- Potentiometric Contours Elevation above MSL
- Approximate Direction of Groundwater Flow

Contours are extrapolated across center of base due to lack of data

SOURCE: TINKER AFB, 1993

The major pathways for migration of contaminants are the USZ and Soldier Creek. Soldier Creek also truncates into a portion of the top of the lower saturated zone (LSZ), a semiconfined/confined aquifer. The LSZ is also reported to have solvents, fuel, and heavy metals in groundwater, though it is less contaminated than the USZ. Some reaches of Soldier Creek may be recharged by the LSZ and USZ aquifers as baseflow and some reaches may discharge to the LSZ and USZ. A secondary exposure pathway is through direct contact with and ingestion of the creek sediments. The risk assessment on surface water was conducted by B&V Waste Science & Technology Corporation (1993b), and is not addressed in this SCGW RI.

The site-specific conceptual model identifies the following components:

- The sources of on-base contaminants are from Building 3001, the industrial wastewater treatment plant (IWTP), and Soldier Creek.
- The off-base business areas (e.g., auto shop, paint shop, dry cleaner, auto salvage yard) are potential sources of contaminants.
- The unconfined and confined aquifers are the primary contaminant pathways.
- The private wells northeast of Tinker AFB are potential receptors although some may be abandoned due to connection (hookup) to the city water system.
- Base-production wells are potential receptors.
- The Soldier Creek and its sediments present a potential direct-contact pathway.

3.5 SPECIFY RI/FS OBJECTIVES

The objective of the RI/FS is to determine the nature and extent of the threat posed by the release or potential release of hazardous substances and to evaluate remedial alternatives to support Tinker AFB decisions on the remedial action. Achieving this broad objective requires that several complicated and interrelated activities be performed, each having objectives, acceptable levels of uncertainty, and attendant data quality requirements. The expression of these objectives in clear precise statements is the first step toward development of a cost-effective program for collection of sufficient data for decision making.

In general, the objectives for this site are the following:

- Determine the extent and concentration of the off-base soil, sediment, and groundwater contamination
- Determine if human receptors are at risk from the ingestion of contaminants
- Determine and evaluate feasible remedial alternatives.

3.6 DETERMINE NEED FOR ADDITIONAL DATA

The available reports have identified potential source materials on base and possible sources off-base, contaminant migration pathways, and potential receptors. The available data are not adequate to complete the RI/FS or to support an RI/FS decision regarding site remediation because of the lack of information on the relationship between the off-base hydrogeology and the hydrologic regime of Soldier Creek.

SECTION 4

DQO STAGE 2 - RI/FS DEVELOPMENT

In Stage 1, the basic decision making process for the RI/FS was identified. The need for additional data to support the RI/FS decision was also identified. The conceptual model developed in Stage 1 will serve as the basis for completion of the Stage 2 elements. In Stage 2 of the DQO process, the information required will be identified, the data quality and quantity required to support the RI/FS will be specified, and the appropriate sampling and analytical methods will be chosen.

Stage 2 is initially undertaken for the overall RI/FS. Once data uses and attendant data quality needs are established for the overall site, the process will be refined for the components of individual tasks. At the completion of individual tasks, results are integrated into the conceptual model and data base for the entire site (Figure 2.1). In this manner, the iterative and interactive DQO process is incorporated in the RI/FS work.

4.1 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: OVERALL RI/FS

Data developed during the RI will be used for:

- Risk assessment
- Site characterization
- Screening and evaluation of remedial alternatives, i.e., FS
- Remedial design (RD).

Table 4.1 summarizes the overall RI/FS data uses and needs.

The organic contaminants are suspected to be leaching into the unconfined aquifer (USZ) from Building 3001. Thus, the contaminants may affect the private wells northeast of Tinker AFB. In addition, high levels of metals above the maximum contaminant levels (MCLs) have been detected in USZ monitoring wells.

The potential for direct contact with contaminated Soldier Creek sediments exists. The extent and magnitude of sediment contamination and the potential risks associated with direct contact and ingestion must be addressed. To adequately assess the risk presented by the sediments, the total area of contaminated sediments must be determined. This value will be used in conjunction with the action level determined during the risk assessment to determine an appropriate remedial action for Soldier Creek.

Table 4.1 Data Uses

Site Name: SCGW
Location: Tinker AFB, OK
Number: ____
Phase: ____

EPA Region
6

Date: May 1994
Contractor: Engineering-Science
Site Manager: John Yu

RI1 RI2 RI3 ERA FS RD RA

Media/Data Use	Site Characterization (Including Health & Safety)	Risk Assessment	Evaluation of Alternatives	Engineering Design of Alternatives	Monitoring During Remedial Action	PRP Determination	Other ____
Source Sampling Type ____							
Soil Sampling	√					√	
Groundwater Sampling	√	√	√			√	
Sediment Sampling	√		√				
Air Sampling							
Biological Sampling							
Other ____							

Note: Check appropriate box(es)

E5/AU40511/DQOPT4-1

Groundwater is the major pathway for migration of contaminants from the suspected sources to the receptors. Information on the movement and contaminant concentration of the groundwater is therefore required.

Consistent with the objectives of the RI/FS as defined in Stage 1, data required to address the overall RI/FS include:

- Data on the extent and magnitude of contaminants in the groundwater, soils, and sediments
- Data concerning the potential migration and timing of migration
- Data on the health and environmental risk due to ingestion of contaminated groundwater and sediments.
- Data on the physical constraints associated with groundwater, soil and sediment extraction, and treatment
- Data on the physical and chemical properties of groundwater, soil, and sediment
- Data related to any residual or sidestream disposal requirements associated with groundwater treatment and onsite soil and sediment remediations or removal and treatment.

4.2 REMEDIAL ALTERNATIVES

The following potential remedial alternatives will be evaluated for groundwater as part of the RI/FS:

- No action
- *In situ* treatment
- Hydraulic containment
- Physical containment
- Groundwater extraction and treatment
- Alternate water supplies

For the groundwater extraction option, a number of treated effluent discharge alternatives will be evaluated, including discharge to municipal sewer, on-base IWTP, deep well injection, discharge to infiltration basins on site or to Soldier Creek. If contaminants are found above levels of concern in drinking water wells, alternate water supplies or wellhead treatment unit (WHTU) may be provided as an expedited response.

In addition to the groundwater pathway, the direct contact pathway for contaminated sediment will be assessed. The potential remedial alternatives for the sediments which will be evaluated as part of the RI/FS include:

- No action
- Excavation and *ex-situ* treatment

- Excavation and off-site treatment and disposal
- Cap and lining
- Enhanced volatilization (organics only)
- Incineration (organics only)
- *In situ* stabilization (metals only)

4.3 IDENTIFY DATA TYPES

Data types required for site evaluation, risk assessment, and evaluation of the remedial alternatives include both chemical and physical characteristics as well as the extent of contamination. Table 4.2 summarizes the data types required to assess remedial alternatives.

The physical properties of the aquifer are important in the evaluation of remedial alternatives which involve groundwater extraction or containment. The physical properties of the aquifer and the spatial data will be utilized in determining the volume of the contaminated plume. Parameters which influence the volume of contaminated groundwater are the horizontal and vertical extent of contaminants (i.e., a three-dimensional outline of the contaminant plume) and the porosity of the aquifer. In any remedial action involving pumping, the volume of water removed is expected to be at least one order of magnitude greater than the volume marked by the boundaries of the plume. Porosity, grain size, and permeability data will also be obtained for the evaluation of enhanced volatilization procedures.

The water quality parameters and the contaminants analyses (volatile organic compounds, semivolatile organic compounds, and metals) obtained from both the private and newly installed monitoring wells will be used to determine the extent of groundwater contamination and to evaluate the applicability of various treatability options. Physical and chemical data required for evaluating treatment and disposal options will also be obtained for soils and sediments.

4.4 IDENTIFY DATA QUALITY AND QUANTITY NEEDS

The various tasks and phases of this remedial investigation will require different levels of data quality and quantity. The data quality and quantity needs for each specific task/phase are listed in the following format:

- Prioritized data uses
- Appropriate analytical levels
- Contaminants of concern
- Levels of concern
- Required detection limit
- Critical samples.

The Development Process manual (EPA, 1987a) provides a thorough description of these parameters in Section 4. Although not always addressed

Table 4.2 RI/FS Data Types
Tinker AFB SCGW RI/FS

Data Types	Groundwater	Soils/Sediment
A) Physical parameters		
Permeability	√	√
Porosity		√
Hydraulic head	√	
Grain size		√
Standard penetration test		√
Particle size distribution		√
Total organic carbon		√
BTU content		
Cation exchange capacity		√
pH		√
B) Water quality parameters		
Common cations* (Ca, Mg, Na, K, Fe)		
Common anions* (SO_4, Cl, NO_3, HCO_3, CO_3)		
pH, temperature, conductance, turbidity (field)	√	
TDS*		
TOC*		
COD		
TSS*		
Hardness*		
Total metals	√	
Dissolved metals		
C) Contaminants		
Volatile organics (TCL)	√	√
Semivolatile organics (TCL)		
Metals: Cd, Cr, (total, III, VI), Ni, Pb, As, Ba, Cu, Hg, Se, Ag, Zn	√	√
Metals: Sb, Be, Tl	√	
Cyanide	√	
Organics screening (HNU/OVA)		√
Metals screening		
D) Spatial Data		
Horizontal extent	√	√
Vertical extent	√	√

* Parameters not listed in SOW but are needed for characterization and FS.

quantitatively, precision and accuracy values for analytical methods are also used to assess data quality.

4.5 EVALUATE SAMPLING AND ANALYSIS OPTIONS

4.5.1 Sampling and Analysis Components

There are several options available for investigating potential groundwater, soil and sediment contamination. The options are based on combinations of the following tasks:

- Sampling existing off-base wells
- Sampling soil and sediments
- Installing and sampling monitoring wells.

The two major types of contaminants of concern are volatile organic compounds and metals. Existing off-base wells in the vicinity of the site will be sampled to determine if contaminants are present. If contaminated, consideration must be given to implementation of an expedited response.

Monitoring wells will be installed based on the results of the literature review. These wells will be used to evaluate the extent of groundwater contamination and may serve as an early warning of contaminant migration towards the private wells.

4.5.2 Sampling and Analysis Approach

The SCGW RI is planned to proceed in a tasked approach with the following tasks:

Task 1 - Historical review and windshield survey

Task 2 - Inspection of twelve private wells

Task 3 - Soldier Creek streamflow survey

Task 4 - Lithologic coring

Task 5 - Monitoring well construction and sampling

Task 6 - Conceptual model

Task 7 - Aquifer tests

Task 8 - Soil sampling

Task 9 - Sediment sampling.

4.5.3 Resource Requirements

Implementation of the field program will require, at a minimum, a drilling crew, a geologist, a hydrologist, and an analytical chemist. The site manager must plan to have these personnel available throughout the drilling and soil sampling phase. Analytical equipment required includes a pH meter, thermometer, conductivity meter, turbidity meter, and analytical support from the CLP-equivalent and/or other certified laboratories.

4.6 REVIEW PARCC PARAMETERS

The PARCC (precision, accuracy, representatives, completeness, and comparability) parameters are overall indictors of data quality and are defined in of the Development Process manual (EPA, 1987a). As with data quality and quantity, the PARCC parameters are specified at the task level and are not specified for the overall RI/FS. Furthermore, PARCC parameters, specifically precision and accuracy (where they are available) are compound, media, and method-specific.

The historical precision and accuracy achieved by different analytical techniques will be reviewed for each task to allow a comparison of the analytical techniques. In addition, representativeness, completeness, and comparability will also be reviewed and addressed.

SECTION 5

DQO DEVELOPMENT REMEDIAL INVESTIGATION

5.1 DQO STAGE 2 IDENTIFY DATA USES AND NEEDS: TASK 1 HISTORICAL REVIEW AND WINDSHIELD SURVEY

5.1.1 Identify Data Uses

Task 1 is planned to determine the relationship between Soldier Creek and the underlying aquifer(s), the mobility, toxicity, and volume (MTV) of the contaminants of concern, and their fate and transport. The literature review will establish a three-dimensional view of a conceptual hydrogeologic model in the selection of monitoring well locations. The well inventory and windshield survey will aid in the selection of the off-base drinking water wells for downhole geophysical survey, groundwater sampling, and soil sampling (Task 2 and Task 3).

Data Use Categories

Site characterization is the major data use category for information derived from Task 1. A secondary use for the data is engineering screening of technology.

5.1.2 Identify Data Types

The data types required are historical records and reports to refine the 3-dimensional conceptual model (Battelle, 1993; Tinker AFB, 1993) as the framework for the subsequent tasks to estimate the extent and concentration ranges of the contaminated groundwater plume. This is composed of on- and off-base IRP and RCRA reports, OSDH private well water quality data, and an Oklahoma Department of Environmental Quality (ODEQ) well inventory. The well inventory should provide well construction and integrity information. The windshield survey should also identify the accessibility of the wells for downhole geophysical logging and groundwater sampling. The windshield survey will also identify possible historical industrial sites that may contribute to localized groundwater contamination. These industrial sites include gas stations, a dry cleaner, an auto repair shop, auto salvage yard, uncontrolled dump sites, etc.

5.1.3 Identify Data Quality Needs

Data Quality Factor

Prioritized data use:	Site characterization
	Evaluation of alternative

Appropriate analytical level: N/A

Contamination of concern: N/A

Level of concern: N/A

Required detection limit: N/A

Critical samples: N/A

The goal of Task 1 is to refine the conceptual model (Battelle, 1993; Tinker AFB, 1993) and the interrelation of contamination sources, pathways, and exposures to human health and the environment. The level of concern for Task 1 is not critical. Because Soldier Creek has been on the NPL since 1987, extensive quality assurance/quality control (QA/QC) by Tinker AFB contractors following NCP and EPA data validation procedures and review by EPA Region VI and OSDH made the published on- and off-base IRP RI reports reliable.

5.1.4 Identify Data Quantity Needs

All published documents will be reviewed in order to understand current conditions and prepare a cost effective investigation and remediation. The documents include:

- Tinker AFB IRP reports
- Tinker AFB underground storage tank reports
- Tinker AFB RCRA facility assessment (RFA) and investigation (RFI) reports
- USGS geology and water supply papers
- Oklahoma Geological Survey (OGS) groundwater papers.

5.1.5 Evaluate Sampling and Analysis Options

Task 1 does not require any chemical analyses.

5.1.6 Review PARCC Parameters

Because there is no sampling associated with Task 1, it is not necessary to review PARCC.

5.2 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 2 INSPECTION OF PRIVATE WELLS

5.2.1 Identify Data Uses

Based on current understanding of the hydrologic system and regime, the on-base contamination sources are in the vicinity of Building 3001 and the IWTP and are located on a groundwater high. The USZ has a northeast vector moving off-base. The USZ may recharge some reaches of Soldier Creek. In turn, Soldier

Creek may recharge groundwater downstream to the USZ and the LSZ, i.e., the Garber-Wellington aquifer. The OSDH has collected data on water wells in the Soldier Creek watershed northeast of the base. Compounds detected in groundwater could not be attributed to the Tinker AFB plume.

Some of the groundwater samples collected from eight off-base private wells by B&V in 1992 contained BTEX (B&V, 1993). Moreover, the wells in which contamination was detected were isolated and could not be used to delineate a plume contiguous to the Tinker AFB plume. Nonetheless, the off-base wells could be exposure points for Tinker AFB solvents, fuel, and heavy metals. Task 2 data use is for site inspection and characterization for:

- Off-base plume definition,
- Establishment of pathway from base to private wells,
- Understanding stratigraphy at each off-base well, and
- Understanding well construction and integrity.

A secondary use of this data is well abandonment or re-conditioning for contaminated groundwater pump-and-treat (P&T). Table 5.1 is the DQO summary form for Task 2.

5.2.2 Identify Data Types

In this RI/FS Task 2, the primary interest is those private wells immediately northeast of the base and south of Interstate Freeway 40 (I-40) as delineated in Figure 2.3. Since this is the first task to thoroughly investigate private wells, this task is equivalent to a site inspection, according to NCP definition. The secondary zone is between 15th Street and I-40. The tertiary zone is the area north of 15th Street.

The type of data to be collected are the 129 priority pollutants (excluding dioxin and asbestos) for groundwater and downhole geophysical logs (gamma, caliper, and TV) for lithology and well integrity. A full list of the 129 priority pollutants are their limits of detection is given in Table 5.2.

5.2.3 Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	Site inspection
Appropriate analytical levels:	Site inspection, I, III, V
Contaminant of concern:	Priority pollutants (excluding dioxin and asbestos)
Level of concern:	Any concentration above MCLs

TABLE 5.1
DQO SUMMARY FORM

1. SITE

NAME SCGW RI
LOCATION Tinker AFB Off-Base
NUMBER Task 2

EPA REGION 6
PHASE
RI 1 RI 2 RI 3 ERA FS RD RA
(CIRCLE ONE)

2. MEDIA (CIRCLE ONE)

SOIL | GW | SW/SED | AIR | BIO | OTHER

3. USE (CIRCLE ALL THAT APPLY)

SITE CHARAC. (H&S) | RISK ASSESS | EVAL ALTS. | ENG'G DESIGN | PRP DETER. | MONITORING REMEDIAL ACTION | OTHER

4. OBJECTIVE Determine or deny contamination of residential wells and their relationship with TAFB plume; collect well lithologic and integrity data.

5. SITE INFORMATION

AREA North of base, South of 15th St.
DEPTH TO GROUND WATER about 100 feet
GROUND WATER USE Drinking water wells
SOIL TYPES Silt, clay with shale and sandstone bedrock
SENSITIVE RECEPTORS Domestic well owners/users

6. DATA TYPES (CIRCLE APPROPRIATE DATA TYPES)

A. ANALYTICAL DATA

pH, CONDUCTIVITY, VOA, ABN, TCLP
PESTICIDES, PCB, METALS, CYANIDE
TOX, TOC, BTX, COD

B. PHYSICAL DATA

PERMEABILITY, POROSITY, GRAIN SIZE, BULK DENSITY
HYDRAULIC HEAD, PENETRATION TEST, HARDNESS

7. SAMPLING METHOD (CIRCLE METHOD(S) TO BE USED)

ENVIRONMENTAL, SOURCE, BIASED, GRID, GRAB, COMPOSITE, NON-INTRUSIVE, INTRUSIVE, PHASED

8. ANALYTICAL LEVELS (INDICATE LEVEL(S) AND EQUIPMENT & METHODS)

LEVEL 1 FIELD SCREENING - EQUIPMENT
LEVEL 2 FIELD ANALYSIS - EQUIPMENT
LEVEL 3 NON-CLP LABORATORY - METHODS Metals and VOA for all samples, 8260/827(
LEVEL 4 CLP/RAS - METHODS
LEVEL 5 NON STANDARD Chromium VI EPA method 218-3 or 7195

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR
CRITICAL (LIST) Wells south of I-40
PROCEDURES Sample at tap or use bailer, purge well first

10. QUALITY CONTROL SAMPLES (CONFIRM OR SET STANDARD)

A. FIELD
COLLOCATED - 5% OR 7 duplicates
REPLICATE - 5% OR 5 MS
FIELD BLANK - 5% OR 5
TRIP BLANK - 1 PER DAY OR 5

B. LABORATORY
REAGENT BLANK - 1 PER ANALYSIS BATCH OR
REPLICATE - 1 PER ANALYSIS BATCH OR
MATRIX SPIKE - 1 PER ANALYSIS BATCH OR
OTHER

11. BUDGET REQUIREMENTS

BUDGET
SCHEDULE 10 days
STAFF 2 persons for field; chemist for data validation

CONTRACTOR Engineering-Science
PRIME CONTRACTOR Engineering-Science
SITE MANAGER John Yu
DATE 4 November 1993

Table 5.2 Limits of Detection (LOD)
Tinker AFB SCGW RI/FS

Method Number and Description/Analyte	Maximum LODs Soil (mg/kg)	Water (μg/L)
SW-8260 - Volatile organic compounds (priority pollutants and contaminants of concern)		
Acrolein	10.0	0.1
Acrylonitrite	10.0	0.1
Benzene	3.0	0.1
bis(Chloromethyl) ether	NA	NA
Bromoform	5.0	0.1
Carbon tetrachloride (Freon 10)	3.0	0.1
Chlorobenzene	5.0	0.1
Chloroethane	10.0	0.1
2-Chloroethyl vinyl ether	10.0	0.1
Chloroform	5.0	0.1
Chloromethane (metyl chloride)	10.0	0.1
cis-1,2-Dichloroethene	NA	NA
Dibromochloromethane (chlorodibromomethane)	5.0	0.1
1,2-Dichlorobenzene	NA	0.1
1,3-Dichlorobenzene	NA	0.1
1,4-Dichlorobenzene	NA	0.1
Dichlorobromomethane (Bromodichloromethane)	5.0	0.1
1,1-Dichloroethane	5.0	0.1
1,2-Dichloroethane	5.0	0.1
1,1-Dichloroethene	3.0	0.1
1,2-Dichloroethene	NA	NA
1,2-trans-Dichloroethene	5.0	0.1
Dichlorodifluoromethane	NA	NA
1,2-Dichloropropane	5.0	0.1
cis-1,3-Dichloropropene	5.0	0.1
trans-1,3-Dichloropropene	5.0	0.1
Ethylbenzene	5.0	0.1
Methyl bromide	NA	NA
Methyl chloride	NA	NA
Methylene chloride	5.0	0.1
1,1,2,2-Tetrachloroethane	5.0	0.1
Tetrachloroethene	3.0	0.1
Toluene	5.0	0.1
1,1,1-Trichloroethane	5.0	0.1
1,1,2-Trichloroethane	5.0	0.1
Trichloroethene	NA	NA
Trichlorofluoromethane	10.0	0.1
1,2,4-Trimethylbenzene	NA	NA
Vinyl chloride	10.0	0.1
Total xylenes (o)	5.0	0.1
Total xylenes (m, p)	5.0	0.1

Table 5.2, continued

Method Number and Description/Analyte	Maximum LODs Soil (mg/kg)	Water (μg/L)
SW-8270-Semivolatile organic compounds (priority pollutants and contaminants of concern)		
<u>**Base/neutral extractables**</u>		
Acenaphthene	10.0	0.5
Acenaphthylene	10.0	0.5
Anthracene	10.0	0.5
Benzidine	50.0	2.5
Benzo(a)anthracene	10.0	0.5
Benzo(b)fluoranthene	10.0	0.5
Benzo(k)fluoranthene (3,4-Benzofluoranthene)	10.0	0.5
Benzo(g,h,i)perylene	10.0	0.5
Benzo(a)pyrene	10.0	0.5
bis(2-Chloroethoxy)methane	10.0	0.5
bis(2-Chloroethyl)ether	10.0	0.5
bis(2-Chloroisopropyl)ether	10.0	0.5
bis(2-Ethylhexyl)phthalate	10.0	0.5
4-Bromophenyl phenyl ether	10.0	0.5
Butyl benzyl phthalate	10.0	0.5
2-Chloronaphthalene	10.0	2.5
4-Chlorophenyl phenyl ether	10.0	0.5
Chrysene	10.0	0.5
Dibenzo(a,h)anthracene	10.0	0.5
Di-n-Butylphthalate	10.0	0.5
1,2-Dichlorobenzene	5.0	0.5
1,3-Dichlorobenzene	5.0	0.5
1,4-Dichlorobenzene	5.0	0.5
3,3'-Dichlorobenzidine	20.0	0.5
Diethyl phthalate	20.0	0.5
Dimethyl phthalate	10.0	0.5
2,4-Dinitrotoluene	10.0	0.5
2,6-Dinitrotoluene	10.0	0.5
Di-n-octyl phthalate	10.0	0.5
1,2-Diphenylhydrazine	50.0	2.5
Fluoranthene	10.0	0.5
Fluorene	10.0	0.5
Hexachlorobenzene	10.0	0.5
Hexachlorobutadiene	10.0	0.5
Hexachlorocyclopentadiene	10.0	0.5
Hexachloroethane	10.0	0.5
Indeno(1,2,3-cd)pyrene	10.0	0.5
Isophorone	10.0	0.5
Naphthalene	10.0	0.5

Table 5.2, continued

Method Number and Description/Analyte	Maximum LODs	
	Soil (mg/kg)	Water (μg/L)
Base/neutral extractables, continued		
Nitrobenzene	10.0	0.5
n-Nitrosodimethylamine	NA	NA
n-Nitroso-di-n-propylamine	10.0	0.5
n-Nitrosodiphenylamine	10.0	0.5
Phenanthrene	10.0	0.5
Pyrene	10.0	0.5
1,2,4-Trichlorobenzene	10.0	0.5
Acid extractables		
4-Chloro-3-methylhenol	10.0	0.5
2-Chlorophenol	10.0	0.5
2,4-Dichlorophenol	10.0	0.5
2,4-Dimethylphenol	10.0	0.5
4,6-Dinitro-2-methylphenol (4,6-Dinitro-o-cresol)	50.0	1.5
2,4-Dinitrophenol	50.0	1.5
2-Methylphenol	10.0	0.5
4-Methylphenol	10.0	0.5
2-Nitrophenol	50.0	0.5
4-Nitrophenol	NA	NA
Parachlorometa cresol	NA	NA
Pentachlorophenol	30.0	1.5
Phenol	10.0	0.5
2,4,5-Trichlorophenol	50.0	1.5
2,4,6-Trichlorophenol	10.0	0.5
Pesticides and PCBs		
Aldrin	NA	NA
a-BHC	NA	NA
b-BHC	NA	NA
q-BHC	NA	NA
w-BHC	NA	NA
Chlorodane	NA	NA
4,4′-DDD	NA	NA
4,4′-DDE	NA	NA
4,4′-DDT	NA	NA
Dieldrin	NA	NA
a-Endosulfan	NA	NA
b-Endosulfan	NA	NA
Endosulfan sulfate	NA	NA
Endrin	NA	NA
Endrin aldehyde	NA	NA
Heptachlor	NA	NA
Heptachlor expoxide	NA	NA
PCB-1242	NA	NA
PCB-1254	NA	NA
PCB-1221	NA	NA
PCB-1232	NA	NA
PCB-1248	NA	NA
PCB-1260	NA	NA
PCB-1016	NA	NA
Toxaphene	NA	NA

Table 5.2, continued

Method Number and Description/Analyte	Maximum LODs Soil (mg/kg)	Water (μg/L)
SW-9010 - Total cyanides	20.0	20.0
	Soil (mg/kg)	Water (μg/L)
SW-6010 - Metals		
Antimony	NA	20
Barium	NA	10
Beryllium	NA	0.2
Cadmium	NA	5
Total Chromium	NA	30
Copper	NA	3
Nickel	NA	40
Silver	NA	3
Thallium	NA	50
Zinc	NA	1
SW-7195-7198 - Chromium VI	NA	NA
SW-7421 - Lead	NA	0.5
SW-7060 - Arsenic	NA	0.5
SW-7470/7471 - Mercury	NA	NA
SW-7740 - Selenium	NA	0.5

NA = not applicable (not determined by basic statement of work or analyte will not be analyzed for)

Required detection limits: Equivalent to EPA contract required detection limits (CRDLs).

The levels of concern shown are typical for site inspection. These MCLs are based on the Safe Drinking Water Act (SDWA) and are determined by the EPA based on health risk and cost-effective analyses (EPA, 1990 and 1988c). Although the city provides water to residents and the city water is routinely monitored for organics and metals under SDWA, there is a potential that residents may reuse the wells that were abandoned. Thus, MCLs are considered to be the levels of concern (Table 5.3).

The critical samples will be those collected from private wells immediately north of the base and south of the I-40, the focused area of Figure 2.3.

5.2.4 Identify Data Quantity Needs

Twelve private wells will be geophysically logged and sampled once. The number of wells was determined from the Task 1 literature review and windshield survey.

5.2.5 Evaluate Sampling and Analysis Options

Sampling and Analysis Components

Priority is given to the off-base private wells in the focus RI/FS area. These wells will be inspected and sampled first. Wells in the conceptual model area will be sampled second. The governing factor for the number and location of wells to be sampled is the budgeted number of wells (fund limitation) and the accessibility to individual wells (physical limitation). If contamination is found in these abandoned wells, Tinker AFB will notify OSDH. Further study may be carried out by Tinker AFB if there is a linkage between the base groundwater contamination plume and the off-base abandoned wells.

Sampling and Analysis Approach

The sampling approach is to collect groundwater from twelve off-base private wells. Existing off-base monitoring wells screened in the same zones as nearby private wells will be preferred.

Options for analysis include CLP-equivalent, local laboratory, mobile laboratory, and on-site analysis. The CLP is an EPA program establishing analytical contract between EPA and laboratory. The CLP requires EPA contract laboratories to complete significant paperwork to backup EPA enforcement and cost reimbursement from PRPs. Tinker AFB may contract a laboratory to do CLP-equivalent work (analytical level IV). The turnaround time is generally over a month and the cost per sample is the highest among the four options.

Using EPA procedures and methodology (SW-846, for instance), a local laboratory can produce analytical level III data that are suitable for risk assessment, PRP identification, site characterization, and evaluation of alternatives. The price

Table 5.3
Tinker AFB SCGW RI/FS
Constituents of Potential Concern
and Corresponding MCLs

Volatile organic compounds (SW-8260)*	MCLs (μg/L)[1]
Benzene	5
Chlorobenzene	100[2]
Chloroform	100
1,1-Dichloroethane	100
1,1-Dichloroethene	NA[3]
cis-1,2-Dichloroethene	70[2]
trans-1,2-Dichloroethene	100[2]
1,2-Dichloropropane	5
Ethylbenzene	700
Methylene chloride	5[2]
Tetrachloroethene	5[2]
Toluene	2,000[2]
1,1,1-Trichloroethane	200
Trichloroethene	5
1,2,4-Trimethylbenzene	NA[3]
Vinyl chloride	2
Xylenes (total)	10,000
Semivolatile organic compounds (SW-8270)*	
Bis (2-ethylhexyl) phthalate	NA[3]
1,2-Dichlorobenzene	NA[3]
1,3-Dichlorobenzene	NA[3]
1,4-Dichlorobenzene	NA[3]
Di-n-octyl phthalate	NA[3]
Naphthalene	NA[3]
Other priority semivolatiles** (including pesticides and PCBs)	
Metals (SW-3005/SW-6010)*	
Antimony**	6
Arsenic	50
Barium	1,000
Beryllium**	2,000
Cadmium	10
Chromium (total)	100
Chromium (VI)	NA[3]
Chromium (III)	NA[3]
Copper	1,300
Lead (SW-3005/SW-7421)	15
Mercury (SW-7470, liquids; SW-7471, solids)	2
Nickel	100
Selenium (SW-7740)	10
Silver	50
Thallium**	2
Zinc	50
Cyanide*** (SW-9010)	200

* The compounds of concern are those contaminants that can be attributed to the Tinker AFB post waste disposal activities EPA solid waste methods.

** Priority pollutants not found in Tinker AFB wells but will be analyzed for groundwater for the newly installed monitoring wells and wells that have never been sampled before.

*** Cyanide is one of the 129 priority pollutants and will be analyzed for groundwater for new wells and wells that have never been sampled before. The other two priority pollutants that will not be analyzed are dioxin and asbestos.

Table 5.3, continued

(1) EPA, 1991. National Primary Drinking Water Regulations. U.S. Environmental Protection Agency. Code of Federal Regulations, Chapter 40, Part 141. As amended through June 1, 1991.

(2) Proposed values

(3) No maximum contaminant level is available for this chemical

per sample is less than the CLP-equivalent price because there is less paperwork. The turnaround time is about one week.

A mobile lab can be used on site to analyze water samples within four to eight hours. However, this produces analytical level II data. The level II data are not suitable for risk assessment. Due to the small number of samples (20), the level II data, and the cost of mobilization, the mobile laboratory is not a desirable choice.

Field test kits and photoionization detectors such as an HNU® or organic vapor analyzer (OVA) can be read in the field to produce level I data for site characterization. Field parameters include pH, temperature, specific conductance, and turbidity. A Hach® kit can be used to measure alkalinity, hardness, iron and other metals. An OVA or HNU can be used to analyze head space air of a half-filled container. This gives a real time and semi-quantitative analysis of solvents and fuel contamination. The turnaround time is very short and the cost is the least.

Because this is the first time that Tinker AFB will sample off-base residential wells, these samples will be analyzed using level I and level III methodology. Level I includes the measurements of pH, temperature, and specific conductance. Level III includes Target Compound List (TCL) volatile and semivolatile organic compounds, cadmium, chromium (total, III, VI), lead, and nickel.

5.2.6 Review PARCC Parameter

The groundwater samples will be analyzed for the 129 priority pollutants (not including dioxins and asbestos). They will be analyzed using SW-846 methods SW-8260 for volatile organic compounds, SW-8270 for semivolatile organic compounds, SW-6010 for metals, SW-7060 for arsenic, SW-7420 for mercury, SW-7740 for selenium, SW-9010 for total cyanides, SW-7421 for lead, and a method to be determined for chromium VI. The DQO example document (EPA, 1987b) lists the methods SW-7470 and SW-9010 precision and accuracies for level III data. The precision and accuracy are not available for the other methods.

Precision

For methods SW-8260 (VOCs), SW-8270 (semivolatiles), SW-6010 (ICP metal scan), SW-7421 (lead for detection limit lower than MCL of 15 $\mu g/L$), SW-7195 (chromium VI), SW-7060 (arsenic) and SW-7740 (selenium), the precisions are unknown. Sufficient QA samples must be collected to determine precision. EPA (1987b) recommends that at least four replicates be collected during the RI to establish precision.

Precision is an expression of the agreement between multiple measurements of the same property carried out under similar conditions. Precision thus reflects the reproducibility of the measurement. Precision is evaluated most directly by recording and comparing multiple measurements of the same parameter made on the same sample under similar conditions.

Precision is expressed in terms of the standard deviation or the relative percent difference (RPD) between the values resulting from duplicate analyses. RPD is calculated as follows:

$$RPD = \frac{|V_1 - V_2|}{(V_1 + V_2)/2} \times 100\%$$

where:

RPD	=	Relative Percent Difference
V_1, V_2	=	The two values obtained by making replicate measurements or analyzing duplicate samples.
$\|V_1 - V_2\|$	=	The absolute value of the difference between the two measurements.
$(V_1 + V_2)/2$	=	The average value of the two measurements.

and RPD = SQRT (2) x RSD

where:

RSD	=	The relative standard deviation (coefficient of variation).
SQRT	=	The square root.

Accuracy

As discussed, only method SW-7470 and SW-9010 have precision and accuracy data. To estimate the accuracy of methods SW-8260, SW-8270, SW-6010, SW-7195 (or other method for hexavalent chromium), SW-7060, SW-7740 and SW-7421 spiked samples have to be analyzed by the laboratory.

A spiked sample contains a known amount of an analyte. If the laboratory method consistently overestimates or underestimates the concentration of spiked samples, the method contains a systematic error or, in statistical terms, the method is biased. The accuracy of the laboratory data will be evaluated by determining the percent recovery (% Rec) of matrix spike samples. The % Rec for spiked samples is calculated as follows:

$$\%\,Rec = \frac{SSR - SR}{SA} \times 100\%$$

where:

% Rec	=	Percent recovery
SSR	=	Measured concentration in spiked sample
SR	=	Measured concentration in unspiked sample
SA	=	Concentration of spike added to the sample.

To efficiently determine accuracy, several spiked samples must be submitted for analyses. As discussed above, uncertainty is reduced by using four data points (replicate). For this reason, four spiked samples will be required to determine accuracy. This will be spiked in the laboratory to a concentration matching the level of concern, such as 5 μg/L for TCE, so that the accuracy of the method can be estimated at the level of concern (EPA, 1987b).

Representativeness

Off-base private wells may be in use or abandoned. Abandoned wells are preferred for geophysically logging and sampling. However, if twelve abandoned wells are not accessible, private wells that are in use will be sampled.

If the well is abandoned but not plugged, and the pump is functional, the water will be purged and sampled at the well head. If the pump is not working, a subcontractor will remove the pump and a submersible pump will be used to purge the well. The water will be sampled using a PVC bailer for organics and metals analyses (EPA, 1992).

To ensure that samples are representative of the water consumed by the residents, samples will be taken from kitchen taps. Taps will be run for five minutes or until three well volumes have been removed prior to sampling. During sampling, the tap flow rate will be reduced so that potential volatilization of organics is reduced. Also any filter or aeration device will be bypassed or removed prior to sampling if possible.

Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system relative to the amount anticipated under ideal conditions. The percent completeness will be calculated as follows:

$$PC = \frac{N_A}{N_I} \times 100\%$$

where:

PC = Percent completeness

N_A = Actual number of valid environmental sample analyses.

N_I = Planned number of environmental sample analyses.

Valid data will be defined as all data and/or qualified data considered to meet the data quality objectives for this project. The planned number of analyses may vary from the samples proposed, due to site-specific conditions.

At the end of the data validation process, an assessment of the completeness will be made. If data gaps are apparent, an attempt will be made to collect the required data. A target completeness of 90 percent for each analytical method has been established.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured by adherence to the approved sample collection procedures, field measurement procedures, and analytical procedures. The comparability of the data will also be ensured through the use of calibration and reference standards.

5.3 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 3 SOLDIER CREEK STREAMFLOW SURVEY

5.3.1 Identify Data Uses

The purpose of Task 3 is to characterize the hydrologic regime of Soldier Creek and to quantify inflow and outflow of Soldier Creek to the underlying USZ and LSZ aquifers. No chemistry data will be collected in Task 3 for risk assessment or site characterization.

Site characterization is the major data use category. The data will be used to quantify the physical relationship between Soldier Creek streamflow and the underlying aquifer.

5.3.2 Identify Data Types

Physical data is required to estimate the recharge of Soldier Creek to groundwater. If reaches where Soldier Creek discharges to groundwater are identified, and the influent rate is determined in association with the groundwater plume originating from Tinker AFB, the potential impact may be characterized.

5.3.3 Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	Site characterization
Appropriate analytical level:	N/A
Contaminant of concern:	N/A
Level of concern:	N/A
Required detection limit:	N/A
Critical samples:	N/A

Although no chemical data is collected, Task 3 data will still have to abide by USGS QC procedures (Corbett, 1943). The error of streamflow gaging to within 5 percent is considered by the USGS to be good quality data. This error level can be met when the minimum velocity at any one vertical section is not less than 0.5 feet per second and the depth of water is sufficient to permit the use of the two-point (0.2 and 0.8 depths) method. Portable flume or weir can also achieve this accuracy and even lower to within 2 percent. Where the error is greater than 8 percent, the measurement is rated poor. Some natural conditions, such as rapid stage rise or fall, ice, and cobble streambed at low flow, prevent good measurements. The critical areas are those reaches that are effluent.

5.3.4 Identify Data Quantity Needs

Factors

Streamflow data will be collected for nine months, preferably during a wet and a dry season. An entire water year was originally considered; however, it was later determined that nine months streamflow data may be sufficient for the interpretation of the hydrologic regime.

Number of Samples

Daily discharge of Soldier Creek will be measured at nine gaging stations (two to be installed in this effort, six are existing) and the influent or effluent fluxes of the Soldier Creek streambed will be estimated. Streambed permeability will be measured at six locations. Three cluster piezometers will be installed at each of the six locations along the Soldier Creek streambed and four rounds of water level measurements will be made.

5.3.5 Evaluate Sampling and Analysis Options

Sampling and Analytical Approaches

No chemical analyses are required for Task 3. All streamflow data collection and analysis will follow the USGS Techniques for Water-Resources Investigation (Corbett, 1943; Buchanan, 1976; Kennedy, 1983; Rantz, 1982; Carter, 1969). The DQO summary is presented in Table 5.4.

5.3.6 Review PARCC Parameters

Because only physical data will be collected in Task 3, there are no special PARCC requirements. Nonetheless, the collected streamflow data must be defensible.

5.4 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 4 LITHOLOGIC CORING

5.4.1 Identify Data Uses

Site characterization is the major data use category for Task 4. Task 4 data will be used to refine the conceptual hydrogeologic model (Battelle, 1993; Tinker AFB, 1993).

5.4.2 Identify Data Types

No chemical data will be collected during Task 4 activities. Coreholes will be lithologically and geophysically (gamma, caliper, spontaneous potential, resistivity, microresistivity, density, and neutron) logged. Samples will be collected from the coreholes for geotechnical analyses.

5.4.3 Identify Data Quantity Needs

Two deep corings were drilled southeast of Building 3001 during historical investigations. These coring data were useful, but limited to on-base. Four 200-foot corings will be sufficient to establish the off-base conceptual hydrogeologic model. In addition, the borehole geophysical surveys of 12 off-base private wells (Task 2) will supplement the corehole information in the development and refining of the model northeast and off-base.

Twenty-four soil samples will be taken for geotechnical parameters from the four coreholes. The parameters are Atterberg limits, particle size, soil moisture, organic content, and permeability. The core will be geophysically logged with gamma ray in a laboratory, slabbed, photographed, and archived.

TABLE 5.4
DQO SUMMARY FORM

1. SITE

NAME SCGW..RI
LOCATION Soldier Creek
NUMBER Task 3

EPA REGION 6

PHASE
RI 1 RI 2 RI 3 ERA FS RD RA
(CIRCLE ONE)

2. MEDIA *(CIRCLE ONE)*	SOIL	GW	SW/SED	AIR	BIO	OTHER

3. USE *(CIRCLE ALL THAT APPLY)*	SITE CHARAC. (H&S)	RISK ASSESS.	EVAL ALTS.	ENG'G DESIGN	PRP DETER.	MONITORING REMEDIAL ACTION	OTHER

4. OBJECTIVE Understand Soldier Creek and groundwater interaction and groundwater to surface water pathway.

5. SITE INFORMATION

AREA East branch to 15th St. DEPTH TO GROUND WATER about 30 feet

GROUND WATER USE drinking

SOIL TYPES silt or clay

SENSITIVE RECEPTORS

6. DATA TYPES *(CIRCLE APPROPRIATE DATA TYPES)*

A. ANALYTICAL DATA

pH	PESTICIDES	TOX
CONDUCTIVITY	PCB	TOC
VOA	METALS	BTX
ABN	CYANIDE	COD
TCLP	N/A	

B. PHYSICAL DATA

PERMEABILITY	HYDRAULIC HEAD
POROSITY	PENETRATION TEST
GRAIN SIZE	HARDNESS
BULK DENSITY	
N/A	

7. SAMPLING METHOD *(CIRCLE METHOD(S) TO BE USED)*

ENVIRONMENTAL	BIASED	GRAB	NON-INTRUSIVE	PHASED
SOURCE	GRID	COMPOSITE	INTRUSIVE	N/A

8. ANALYTICAL LEVELS *(INDICATE LEVEL(S) AND EQUIPMENT & METHODS)*

LEVEL 1 FIELD SCREENING - EQUIPMENT N/A
LEVEL 2 FIELD ANALYSIS - EQUIPMENT N/A
LEVEL 3 NON-CLP LABORATORY - METHODS N/A
LEVEL 4 CLP/RAS - METHODS N/A
LEVEL 5 NON STANDARD N/A

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR
CRITICAL (LIST)
PROCEDURES USGS TWRI Book 1 series

10. QUALITY CONTROL SAMPLES *(CONFIRM OR SET STANDARD)*

A. FIELD
COLLOCATED - 5% OR N/A
REPLICATE - 5% OR N/A
FIELD BLANK - 5% OR N/A
TRIP BLANK - 1 PER DAY OR N/A

B. LABORATORY
REAGENT BLANK - 1 PER ANALYSIS BATCH OR
REPLICATE - 1 PER ANALYSIS BATCH OR
MATRIX SPIKE - 1 PER ANALYSIS BATCH OR
OTHER

11. BUDGET REQUIREMENTS

BUDGET SCHEDULE May 1994 to February 1995
STAFF two hydrologist

CONTRACTOR Battelle PRIME CONTRACTOR Engineering-Science
SITE MANAGER John Yu DATE

5.4.4 Evaluate Sampling and Analysis Options

The DQO process is summarized in Table 5.5. Continuous cores will be taken using a diamond tool and the wire line retrieval method. Cores will be slabbed on site for geotechnical parameter analyses. The samples for geotechnical analyses will be taken by a geologist at lithology changes to represent each strata. To establish the frame of the conceptual model, the four 200-foot corings are located within the conceptual model area (Figure 2.3).

5.4.5 Review of PARCC Parameters

Task 4 is for the physical, not chemical, characteristics of the subsurface hydrogeology. The PARCC developed for chemical quality control generally does not apply to lithologic identification. An example of this is that two geologists using the same Munsell color chart may not give the same color identification. However, the ES (1992) standard operation procedures (SOPs) and ASTM methods will enhance the duplicability of interpretation by different geologists. Coupled with SOPs, confirmation analyses will also enhance PARCC. In Task 4, the lithology will be cross-checked with seven borehole geophysical logs. To ensure that the data is comparable good geologist practices, ES's SOPs, and ASTM methods must be followed during Task 4 activities.

5.5 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 5 MONITORING WELL CONSTRUCTION AND SAMPLING

Twelve monitoring well clusters will be constructed during Task 5 activities. Each cluster is composed of three wells at about 40-foot, 90-foot, and 150-foot depths. A 180-foot-deep pilot hole will be drilled; geophysically logged with calipers, gamma ray, spontaneous potential, and resistivity tools; and plugged. The screened interval will be determined after analyzing lithologic and geophysical logs with Battelle and Tinker AFB hydrogeologists. One round of groundwater samples will be collected from these thirty-six monitoring wells for analysis of the 129 priority pollutants (excluding dioxins and asbestos). The project work plan will give the locations and rationale. However, the majority of the wells planned are located in the focus RI/FS area, i.e., northeast of Tinker AFB and south of I-40.

5.5.1 Identify Data Uses

The off-base groundwater report (USACE, 1991b) and the Soldier Creek RI report (B&V, 1993a) indicated that the USZ has a northeast flow component and the flow is terminated at approximately I-40. The most important potential exposure route is groundwater ingestion. The compounds of concern are TCEthe priority pollutants (excluding dioxins and asbestos).

The lithological information will be used to construct a conceptual hydrogeologic model that will be coupled with the existing on-base model (Battelle, 1993; Tinker AFB, 1993). This model will establish or deny the existence of a pathway between the on-base plume to the off-base residential wells. The lithologic data will also be used to evaluate and screen remedial alternatives.

TABLE 5.5
DQO SUMMARY FORM

1. SITE

NAME SCGW RI
LOCATION TAFB
NUMBER Task 4

EPA REGION 6

PHASE
RI 1 RI 2 RI 3 ERA FS RD RA
(CIRCLE ONE)

2. MEDIA (CIRCLE ONE)

SOIL	GW	SW/SED	AIR	BIO	OTHER

3. USE (CIRCLE ALL THAT APPLY)

SITE CHARAC. (H&S)	RISK ASSESS.	EVAL ALTS.	ENGG DESIGN	PRP DETER.	MONITORING REMEDIAL ACTION	OTHER

4. OBJECTIVE Refine and extend on-base hydrogeologic conceptual model to off-base in the northeast quadrangle.

5. SITE INFORMATION

AREA Conceptual Study Area DEPTH TO GROUND WATER

GROUND WATER USE

SOIL TYPES

SENSITIVE RECEPTORS

6. DATA TYPES (CIRCLE APPROPRIATE DATA TYPES)

A. ANALYTICAL DATA

pH	PESTICIDES	TOX
CONDUCTIVITY	PCB	TOC
VOA	METALS	BTX
ABN	CYANIDE	COD
TCLP		

B. PHYSICAL DATA

PERMEABILITY	HYDRAULIC HEAD
POROSITY	PENETRATION TEST
GRAIN SIZE	HARDNESS
BULK DENSITY	
Atterberg limits	organic contents

7. SAMPLING METHOD (CIRCLE METHOD(S) TO BE USED)

ENVIRONMENTAL	BIASED	GRAB	NON- INTRUSIVE	PHASED
SOURCE	GRID	COMPOSITE	INTRUSIVE	

8. ANALYTICAL LEVELS (INDICATE LEVEL(S) AND EQUIPMENT & METHODS)

LEVEL 1 FIELD SCREENING - EQUIPMENT

LEVEL 2 FIELD ANALYSIS - EQUIPMENT

LEVEL 3 NON-CLP LABORATORY - METHODS

LEVEL 4 CLP/RAS - METHODS

LEVEL 5 NON STANDARD ASTM D4318, 422, 4959, 2974, 2434

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR

CRITICAL (LIST)

PROCEDURES

10. QUALITY CONTROL SAMPLES (CONFIRM OR SET STANDARD)

A. FIELD
COLLOCATED - 5% OR N/A
REPLICATE - 5% OR N/A
FIELD BLANK - 5% OR N/A
TRIP BLANK - 1 PER DAY OR N/A

B. LABORATORY
REAGENT BLANK - 1 PER ANALYSIS BATCH OR N/A
REPLICATE - 1 PER ANALYSIS BATCH OR N/A
MATRIX SPIKE - 1 PER ANALYSIS BATCH OR N/A
OTHER

11. BUDGET REQUIREMENTS

BUDGET SCHEDULE June 1994 - August 1994

STAFF two geologists

CONTRACTOR Engineering-Science PRIME CONTRACTOR

SITE MANAGER John Yu DATE November 1993

FOR DETAILS SEE SAMPLING & ANALYSIS PLAN

CDM SF DQO 1.002

Site characterization (including risk assessment) is the major data use category for information derived during Task 5 activities. A minor data use is engineering screening of alternatives. Table 5.6 lists the data use categories.

5.5.2 Identify Data Types

Task 5 focuses on off-base groundwater contamination, specifically the 129 priority pollutants (excluding dioxin and asbestos). To assess the magnitude of the potential threat associated with ingestion of contaminated groundwater, the newly installed monitoring wells will be sampled and analyzed for those parameters listed in Table 5.5.

5.5.3. Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	Site characterization Risk assessment Evaluation of remedial alternatives
Appropriate analytical levels:	Risk assessment III, V Site characterization I, III, V Evaluation of alternatives I, III, V
Contaminants of concern:	Priority pollutants (excluding dioxin and asbestos)
Level of concern:	MCLs
Required detection limits:	Detection limits must be lower than MCLs
Critical samples:	Clean samples at outer boundary of the plume.

The levels of concern are those which exceed MCLs. Risk assessment for certain carcinogens may require detection limits lower than MCLs. For example, if the MCL for a certain contaminant is 5 μg/L and the detection limit is also 5 μg/L, the confidence of nondetect would be considered weak.

To assess the threat to human health by groundwater ingestion, quantitative data on the concentrations of organics and inorganics must be obtained.

5.5.4 Identify Data Quantity Needs

Data is needed to provide an understanding of the northern extent of the Tinker AFB plume and its vertical distribution. Data is also needed to determine if there is interaction between the LSZ and Soldier Creek, and the USZ and Soldier Creek. Former studies (USACE, 1991b; B&V, 1993a) indicate that the USZ does not extend north of I-40. Thus, the majority of the monitoring wells will be installed in the focus RI/FS area (Figure 2.3). It is estimated that twelve clusters may delineate the off-base plume northern boundary. As stated before, each cluster has three monitoring wells, one screened in the USZ and two screened in the LSZ. The FSP describes how double and triple casing methods will be used to prevent cross-contamination from the USZ to the LSZ.

TABLE 5.6

DQO SUMMARY FORM

1. SITE

NAME SCGW RI/FS

LOCATION TAFB

NUMBER Task 5

EPA REGION 6

PHASE

RI 1 RI 2 RI 3 ERA FS RD RA

(CIRCLE ONE)

2. MEDIA (CIRCLE ONE)

SOIL	GW	SW/SED	AIR	BIO	OTHER

3. USE (CIRCLE ALL THAT APPLY)

SITE CHARAC. (H&S)	RISK ASSESS.	EVAL ALTS.	ENGG DESIGN	PRP DETER.	MONITORING REMEDIAL ACTION	OTHER

4. OBJECTIVE Install and sample twelve well clusters to establish a 3-D groundwater plume definition in the focus and conceptual model areas.

5. SITE INFORMATION

AREA Focus & conceptual areas DEPTH TO GROUND WATER 30 ft and 50 ft

GROUND WATER USE Used to be domestic water supply in the FS area.

SOIL TYPES Silt and clay; bedrocks are shale, sandstone, and silt.

SENSITIVE RECEPTORS Resident immediately NE of TAFB

6. DATA TYPES (CIRCLE APPROPRIATE DATA TYPES)

A. ANALYTICAL DATA

pH, CONDUCTIVITY, VOA, ABN, TCLP

PESTICIDES, PCB, METALS, CYANIDE

TOX, TOC, BTX, COD

TDS, T^oC

common cations & anions

B. PHYSICAL DATA

PERMEABILITY, POROSITY, GRAIN SIZE, BULK DENSITY

HYDRAULIC HEAD, PENETRATION TEST, HARDNESS

7. SAMPLING METHOD (CIRCLE METHOD(S) TO BE USED)

ENVIRONMENTAL, BIASED, GRAB, NON-INTRUSIVE, PHASED

SOURCE, GRID, COMPOSITE, INTRUSIVE

8. ANALYTICAL LEVELS (INDICATE LEVEL(S) AND EQUIPMENT & METHODS)

LEVEL 1 FIELD SCREENING - EQUIPMENT pH, SC, T^oC meters, HNU, turbidity

LEVEL 2 FIELD ANALYSIS - EQUIPMENT Fe Hack kit

LEVEL 3 NON-CLP LABORATORY - METHODS Metals, 6010, ABN 8270, VOA 8260, 7470, 9010, 7060, 7740

LEVEL 4 CLP/RAS - METHODS

LEVEL 5 NON STANDARD Cr VI 7421; cation; anion, 300, TDS 180.1

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR

CRITICAL (LIST) Wells along I-40

PROCEDURES purge three well volume and sample with bailer

10. QUALITY CONTROL SAMPLES (CONFIRM OR SET STANDARD)

A. FIELD

COLLOCATED - 5% OR

REPLICATE - 5% OR

FIELD BLANK - 5% OR

TRIP BLANK - 1 PER DAY OR

B. LABORATORY

REAGENT BLANK - 1 PER ANALYSIS BATCH OR

REPLICATE - 1 PER ANALYSIS BATCH OR

MATRIX SPIKE - 1 PER ANALYSIS BATCH OR

OTHER

11. BUDGET REQUIREMENTS

BUDGET SCHEDULE August - November 1994

STAFF four geologist, one chemist, one technician

CONTRACTOR Engineering-Science PRIME CONTRACTOR

SITE MANAGER John Yu DATE November 1993

The number of cluster wells is based on the information gained from the off-base monitoring wells installed by Tinker AFB (TOB series) and the Tinker AFB conceptual model (Battelle, 1993; Tinker AFB, 1993).

5.5.5 Evaluate Sampling and Analysis Options

Sampling and Analysis Approach

Groundwater from the twelve clusters (a total of thirty-six wells) will be sampled according to the FSP. Wells will not be sampled until two weeks after well development to allow the well to recover. A round of water level measurements will be taken before purging. The volume of groundwater to be purged is a function of hydraulic conductivities of the formation but should generally be about three well volumes.

The samples will be analyzed for compounds of concern listed in Table 5.3 to provide level III data. Because chromium VI has a 24-hour holding time, close coordination between field personnel and the laboratory is a must. The wells will be sampled from the least contaminated to the most contaminated. In this case, the northern most wells will be sampled first. This may reduce interwell cross-contamination.

The sampling sequence is (1) volatile organic compounds, (2) semivolatile organic compounds, (3) heavy metals (Cd, Cr, (total, III, VI), Ni, As, Sb, Ba, Be, Cu, Hg, Se, Ag, Tl, Zn, and Pb, and cyanide and (4) pretreatment and natural water quality parameters such as TDS, TOC, iron, hardness, alkalinity, common cations and anions, pH, temperature, and specific conductance. It is better to analyze alkalinity, pH, temperature, and specific conductance in the field, because these concentrations tend to change with time.

5.5.6 Review PARCC Parameters

The levels of concern and the analytical levels are the same as those discussed in Section 5.2.6.

5.6 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 6 CONCEPTUAL MODEL

A three-dimensional conceptual model for geology, hydrogeology, and surface water-groundwater interaction will be developed. This task is an addition to, and continuation of, an on-base model currently under Tinker AFB contract to Battelle. Task 6 extends the on-base conceptual model to off-base in the area of concern (AOC), i.e., the conceptual model study area.

5.6.1 Identify Data Uses

One objective of this RI/FS is to determine the pathways of groundwater and Soldier Creek sediments to potential receptors off-base. If the pathway is complete, the objective also requires an estimate of risk to humans and fauna. If the risk assessment determines that the cancer risk is above 10^{-4} or the hazardous index is above 1, the objective also requires selection of a cost-effective remedial alternative(s).

Site characterization is the major data use category. The secondary data use category is risk assessment and engineering evaluation of remedial alternatives.

5.6.2 Identify Data Types

Data types required to understand the surface and subsurface hydrologic system on- and off-base includes both physical and chemical data. The physical model is built upon Battelle's current work and the conceptual model of Tinker AFB.

Information from the downhole geophysical surveys (Task 2), the Soldier Creek influent/effluent survey (Task 3), and the lithologic logs of the pilot holes (Task 4) will be required to complete this task.

To delineate the groundwater plume in three dimensions, chemical data will be collected in Tasks 2 and 5. Because Task 6 uses data collected from other tasks, no DQO summary forms are required.

5.6.3 Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	Site characterization Evaluation of remedial alternatives
Appropriate analytical levels:	Site characterization I, III Evaluation of alternatives I, III
Contaminants of concern:	Priority pollutants (excluding dioxin and asbestos) or TCL compounds
Level of concern:	MCLs
Required detection limits:	At least lower than MCLs
Critical samples:	Clean samples (wells) at outer boundary of the plume.

5.6.4 Identify Data Quantity Needs

As discussed in Section 5.6.3, Task 6 is based on the data acquired during Task 2, 3, 4, and 5 activities. To a minor degree, data from private well soil sampling (Task 8) and Soldier Creek sediment sampling (Task 9) may also be used.

The amount of data that will be available are:

- Twelve private wells downhole geophysical logs (three logs per well)
- Analytical data on twelve groundwater samples
- Four 200-foot corehole lithologic logs with seven geophysical logs for each corehole
- Twelve 180-foot pilot hole lithologic logs and four geophysical logs for each pilot hole
- Soldier Creek influent and effluent study of nine month duration
- Water quality data from thirty-six wells (12 clusters)

- Results from the aquifer pumping tests.

5.6.5 Evaluate Sampling and Analysis Options

There are no specific requirements since no chemical data are to be analyzed in Task 6.

5.6.6 Review PARCC Parameters

As noted earlier, Task 6 is the development of a conceptual model using physical and chemical data collected from other tasks. Task 6 PARCC will be built upon PARCC's from other tasks.

Precision

Precision measures the reproducibility of measurements under a given set of conditions. Since the term "conceptual" implies subjective interpretation by geologists, hydrogeologists, and hydrogeochemists, precision is a relative term. The geologist's analytical precision is relatively crude compared to laboratory chemical analytical precision. A geologic interpretation (or measurement) may be in feet or tenths of a foot while a chemical interpretation of a TCE sample may be in parts per billion.

Nonetheless, the hydrologic conceptual model must establish groundwater flow, and thus, plume migration. As described in the DQO guidance document (1987b), sampling precision can be measured by collecting and analyzing a field replicate sample. Precision of a conceptual model could be measured by different hydrogeologists constructing their own conceptual model using the same set of information.

Accuracy

Accuracy measures the bias of a measurement system. It is difficult to measure the accuracy of a conceptual hydrologic model. To check the accuracy of a conceptual model, a peer review may be required to indicate that the model is biased or not. There are no specific requirements to show representativeness, completeness, or comparability.

5.7 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS TASK 7 AQUIFER TESTS

Three long term aquifer pumping tests will be performed in the area of investigation to determine aquifer parameters (specific yield, horizontal permeability, coefficient of storage, transmissivity, confining layer leakage and impact on East and West Soldier Creek) for the conceptual model of Tinker AFB. The tests will be performed on three aquifer zones at approximate depths of 40 feet, 90 feet, and 150 feet. Each of the three aquifer pump tests will be conducted in the same manner. The monitoring wells installed in Task 5 and any other wells deemed appropriate in Task 2 will be selected as observation wells (OW).

A well cluster used for the test will be installed near monitoring wells. The location and rationale of the pumping well cluster will be discussed in the WP.

5.7.1 Identify Data Uses

The primary data use category is site characterization. Hydraulic conductivity is one of the geohydraulic parameters derived from the aquifer test. Hydraulic conductivity is necessary to estimate groundwater flow, and thus, the distance of contaminant migration. The test may indicate if there is hydraulic communication between the USZ and the LSZ. The on-base cross-zone contamination is caused by improper construction of water supply and monitoring wells and by possible leakage of the confining layer between the USZ and the LSZ and among layers of the LSZ. Currently, Tinker AFB is plugging and abandoning (P&A) improperly constructed wells. If this P&A is successful, the vertical leakage through the confining layer(s) would be considered in groundwater remediation.

5.7.2 Identify Data Types

To assess the validity of the conceptual model to be developed in Task 6 qualitatively and quantitatively, Task 7 has to collect geohydraulic parameters listed before in Section 5.7.

For investigation derived waste (IDW) disposal, the pumped water from each of the three tests will be sampled for waste characterization. Due to logistical reasons, the pumping wells will probably be located close to Tinker AFB, perhaps within the TCE plume. Table 5.7 summarizes the data type requirements.

5.7.3 Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	Site characterization Evaluation of alternatives Engineering design
Appropriate analytical levels:	Site characterization: I Evaluation of alternatives: I, III Engineering design: I, III
Contaminants of concern:	Priority pollutants (excluding dioxin and asbestos)
Levels of concern:	MCLs and TCLPs
Required detection limits:	CRDLs
Critical samples:	N/A

If the pumping wells are considered to be a point of consumption, then MCLs are the level of concern. To determine if the pumping water is RCRA waste or not, the TCLP concentration (TCE at or above 500 μg/L) is the level of concern.

5.7.4 Identify Data Quantity Needs

Aquifer test by seven-day pumping is an expensive endeavor. Task 7 is therefore budgeted for three tests; one at each screened interval, corresponding to monitoring wells to be installed in Task 5. Three sets of geohydraulic parameters will be estimated from these three pumping tests.

TABLE 5.7

DQO SUMMARY FORM

1. SITE

NAME SCGW RI/FS

LOCATION TAFB

NUMBER Task 7

EPA REGION 6

PHASE ______
RI 1 RI 2 RI 3 ERA FS RD RA
(CIRCLE ONE)

2. MEDIA *(CIRCLE ONE)*

SOIL	GW	SW/SED	AIR	BIO	OTHER ______

3. USE *(CIRCLE ALL THAT APPLY)*

SITE CHARAC. (H&S)	RISK ASSESS.	EVAL. ALTS.	ENG'G DESIGN	PRP DETER.	MONITORING REMEDIAL ACTION	OTHER ______

4. OBJECTIVE ______

5. SITE INFORMATION

AREA focus RI/FS area DEPTH TO GROUND WATER 30 to 50 ft

GROUND WATER USE potential drinking water source for off-base

SOIL TYPES silt, clay

SENSITIVE RECEPTORS residentials

6. DATA TYPES *(CIRCLE APPROPRIATE DATA TYPES)*

A. ANALYTICAL DATA

pH	PESTICIDES	TOX
CONDUCTIVITY	PCB	TOC
VOA	METALS	BTX
ABN	CYANIDE	COD
TCLP	______	______

B. PHYSICAL DATA

PERMEABILITY	HYDRAULIC HEAD
POROSITY	PENETRATION TEST
GRAIN SIZE	HARDNESS
BULK DENSITY	______
leakage	______

7. SAMPLING METHOD *(CIRCLE METHOD(S) TO BE USED)*

ENVIRONMENTAL	BIASED	GRAB	NON- INTRUSIVE	PHASED
SOURCE	GRID	COMPOSITE	INTRUSIVE	______

8. ANALYTICAL LEVELS *(INDICATE LEVEL(S) AND EQUIPMENT & METHODS)*

LEVEL 1 FIELD SCREENING - EQUIPMENT ______

LEVEL 2 FIELD ANALYSIS - EQUIPMENT ______

LEVEL 3 NON-CLP LABORATORY - METHODS 8260, 8270, 6010, 7421, 7470, 9010, 7060, 7740

LEVEL 4 CLP/RAS - METHODS ______

LEVEL 5 NON STANDARD ______

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR N/A

CRITICAL (LIST) ______

PROCEDURES two samples at wellhead for IDW disposal; one per day for SC

10. QUALITY CONTROL SAMPLES *(CONFIRM OR SET STANDARD)*

A. FIELD

COLLOCATED - 5% OR -0-

REPLICATE - 5% OR -0-

~~FIELD BLANK - 5% OR~~ -0-

TRIP BLANK - 1 PER DAY OR ______

B. LABORATORY

REAGENT BLANK - 1 PER ANALYSIS BATCH OR ______

REPLICATE - 1 PER ANALYSIS BATCH OR ______

MATRIX SPIKE - 1 PER ANALYSIS BATCH OR ______

OTHER ______

11. BUDGET REQUIREMENTS

BUDGET ______ SCHEDULE November - December 1994

STAFF three hydrologists

CONTRACTOR Engineering-Science PRIME CONTRACTOR ______

SITE MANAGER John K. Yu DATE November 1993

FOR DETAILS SEE SAMPLING & ANALYSIS PLAN

CDM SF DQO 1.002

5.7.5 Evaluate Sampling and Analysis Options

All of the groundwater samples will require level III analyses from an off-site laboratory. As an option, a mobile GC laboratory that produces level II data may be used. However, level II data are not suitable for risk assessment and RCRA waste classification. The advantage to using a mobile GC is that the unit cost per sample may be less than the unit costs for offsite laboratory analysis, if a large number of samples are to be analyzed. Therefore, a contaminant concentration - time series analysis can be performed using a mobile GC.

The level I field screening data can be collected using a PID for headspace analysis. During the seven days continuous pumping test for each screened zone, a PID can be used periodically to monitor headspace of pumped water. A Hach® test kit may be used for heavy metal field analysis, but the detection limits may be higher than MCLs for some metals.

5.7.6 Review PARCC Parameter

As stated by EPA (1987a), the PARCC parameters are an indication of data quality. Section 5.2.6 can be referred to for a discussion of applicable PARCC parameters.

5.8 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 8 SOIL SAMPLING NEAR PRIVATE WELLS

Four soil samples will be collected in the vicinity of each private well identified in Task 2 as contaminated. The samples will be analyzed for TCL organics and TAL cadmium, chromium (total, III, VI), nickel, arsenic, antimony, barium, copper, mercury, selenium, silver, zinc, and lead. The samples will be collected at depths of 0, 1, 2.5, and 5 feet with a hand auger.

5.8.1 Identify Data Uses

The data from Task 8 will be used for source identification. A minor use of data from Task 8 is for site characterization. Table 5.8 summarizes the data use category. Because the soils of the off-base wells are not contiguous to the base contaminated soils that are directly underneath Building 3001, Tinker AFB will not perform a risk assessment for soils. If soil contamination is found at the private wellhead, that contamination may provide a source of the contamination found in the adjacent well.

5.8.2 Identify Data Types

The focus of Task 8 is to sample soil at the private wells. The compounds of concern are the same as those found in Tinker AFB groundwater plume, i.e., TCE, DCE, PCE, Cd, Cr (total, III, VI), Ni, Pb.

5.8.3 Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	PRP identification Site characterization

TABLE 5.8
DQO SUMMARY FORM

1. SITE

NAME SCGW RI/FS
LOCATION TAFB
NUMBER Task 8

EPA REGION 6

PHASE
RI 1 RI 2 RI 3 ERA FS RD RA
(CIRCLE ONE)

2. MEDIA (CIRCLE ONE)

SOIL	GW	SW/SED	AIR	BIO	OTHER

3. USE (CIRCLE ALL THAT APPLY)

SITE CHARAC. (H&S)	RISK ASSESS.	EVAL ALTS.	ENGG DESIGN	PRP DETER.	MONITORING REMEDIAL ACTION	OTHER

4. OBJECTIVE Identify sources of off-base contamination at private wellheads.

5. SITE INFORMATION

AREA Conceptual Model area DEPTH TO GROUND WATER 50 ft

GROUND WATER USE potential water supply

SOIL TYPES silt and clay

SENSITIVE RECEPTORS residences

6. DATA TYPES (CIRCLE APPROPRIATE DATA TYPES)

A. ANALYTICAL DATA

pH	PESTICIDES	TOX
CONDUCTIVITY	PCB	TOC
VOA	METALS	BTX
ABN	CYANIDE	COD
TCLP		

B. PHYSICAL DATA

PERMEABILITY	HYDRAULIC HEAD
POROSITY	PENETRATION TEST
GRAIN SIZE	HARDNESS
BULK DENSITY	

7. SAMPLING METHOD (CIRCLE METHOD(S) TO BE USED)

ENVIRONMENTAL	BIASED	GRAB	NON-INTRUSIVE	PHASED
SOURCE	GRID	COMPOSITE	INTRUSIVE	

8. ANALYTICAL LEVELS (INDICATE LEVEL(S) AND EQUIPMENT & METHODS)

LEVEL 1 FIELD SCREENING - EQUIPMENT

LEVEL 2 FIELD ANALYSIS - EQUIPMENT

LEVEL 3 NON-CLP LABORATORY - METHODS 8260, 8270, 6010, 7421, 7471, 7060, 7740

LEVEL 4 CLP/RAS - METHODS

LEVEL 5 NON STANDARD

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR N/A

CRITICAL (LIST) N/A

PROCEDURES Hand auger sample at 0, 1, 2.5, and 5 feet depths

10. QUALITY CONTROL SAMPLES (CONFIRM OR SET STANDARD)

A. FIELD
COLLOCATED - 5% OR 15
REPLICATE - 5% OR
FIELD BLANK - 5% OR 5
TRIP BLANK - 1 PER DAY OR 5

B. LABORATORY
REAGENT BLANK - 1 PER ANALYSIS BATCH OR
REPLICATE - 1 PER ANALYSIS BATCH OR
MATRIX SPIKE - 1 PER ANALYSIS BATCH OR
OTHER

11. BUDGET REQUIREMENTS

BUDGET SCHEDULE February and March 1995

STAFF One geologist and one technician

CONTRACTOR Engineering-Science PRIME CONTRACTOR

SITE MANAGER John K. Yu DATE November 1993

Appropriate analytical levels:	PRP identification: III, IV
Contaminants of concern:	Target Compound List (TCL) of compounds and metals (As, Ba, Cd, Cr, Cr^{+3}, Cr^{+6}, Cu, Pb, Hg, Ni, Se, Ag, and Zn)
Level of concern:	CRDLs (EPA, 1987a)
Required detection limits:	CRDLs
Critical samples:	N/A

There are no off-base soil data on contaminants of concern. It is therefore difficult to determine the levels of concern for naturally occurring heavy metals in soils. However, any detection of volatile organic compounds, such as TCE, DCE, and PCE, is of interest because they are not naturally occurring.

Furthermore, the amount of soil contamination necessary to cause groundwater contamination is a question that demands an answer. Nonetheless, if the concentration of organic contaminants increase with depths, it will be more likely that soil contamination is linked to groundwater contamination.

Background soil metals may have to be established for each formation. If background soils data are required data from the USGS (Elemental Composition of Surficial Materials from Central Oklahoma, Mosier, et.al., 1991) will be used. For example, the Garber Formation contains barite, but the unconsolidated alluvial and terrace deposits do not. It is expected that barium concentrations in the Garber Formation soil and groundwater will be higher than in the unconsolidated deposits though barite may not be a material used by Tinker AFB.

To assess the possible sources of contamination, quantitative information on the concentration of metals and organics must be obtained.

5.8.4 Identify Data Quantity Needs

The objective of Task 8 is to collect soil samples at twelve private wellheads. The sample will be biased because only one hand auger hole is budgeted for source identification.

5.8.5 Evaluate Sampling and Analysis Options

Level III data is required for PRP identification. Therefore, an offsite laboratory will be required for Task 8 sampling activities. At this site inspection stage, as discussed in Task 2, additional laboratory paperwork commensurate with EPA CLP RAS (level VI) is not necessary.

5.8.6 Review PARCC Parameters

Precision

Collocated samples for organic analyses and duplicate samples of the homogenized soil for metals may allow the estimation of precision. However, for volatile organic analytes, the collocated sample may not render an estimate of precision due to soil heterogeneity. Soils cannot be homogenized due to volatilization by mixing.

Accuracy

Due to organic matter present in the soil, spiked soil samples may have a reduced recovery rate. Nonetheless, correct application of the SOP during sampling and laboratory QC will enhance the analytical data accuracy.

Representativeness

The geologist/soil scientist/chemist will collect soil samples for off-base source identification. The soil sample is not selected through a random table or through a grid. The sample will most likely be taken from a location at which the vegetation is stressed, discolored and/or odorous.

Completeness

No specific requirements for Task 8.

Comparability

The use of standard soil sampling procedures and EPA analytical methods will result with the data being comparable with other data of the same type.

5.9 DQO STAGE 2 - IDENTIFY DATA USES AND NEEDS: TASK 9 SOLDIER CREEK SEDIMENT SAMPLING

Sediment samples will be collected from Soldier Creek to establish and evaluate past contamination. The focus is to establish a vertical contaminant concentration gradient at effluent reaches where the USZ, or perhaps the top of the LSZ, discharges into Soldier Creek.

Twenty locations will be sampled, with five samples collected from each location at depths of 0, 1, 2, 3, and 5 feet below ground level. These grab samples will be analyzed for TCL organics, Cd, Cr, (total, III, VI), Ni, As, Sb, Ba, Cu, Hg, Se, Ag, Zn, and Pb. Table 5.9 gives the DQO summary.

5.9.1 Identify Data Uses

The Soldier Creek surface and subsurface RI (B&V, 1993a) and the risk assessment (B&V, 1993b) dealt with surface water characterization and surface water and sediment risk evaluation. During those investigations, instantaneous streamflow measurements and grab samples were obtained, but did not quantitatively address the surface water/groundwater interaction. Task 9 of the SCGW RI/FS will focus on reaches in Soldier Creek that discharges to groundwater.

The primary data use category is site characterization and risk assessment. A minor data use category is the remedial alternative evaluation.

5.9.2 Identify Data Types

In this phase, creek bed sediment contamination is the prime focus. The contaminants found in the Tinker AFB groundwater plumes will be considered. These include TCE, PCE, DCE, Cd, Cr (total, III, VI), Ni, and Pb. This task will help determine the contaminant concentrations and partitioning of the dissolved

TABLE 5.9

DQO SUMMARY FORM

1. SITE

NAME SCGW RI/FS
LOCATION TAFB
NUMBER Task 9

EPA REGION 6

PHASE
RI 1 RI 2 RI 3 ERA FS RD RA
(CIRCLE ONE)

2. MEDIA (CIRCLE ONE)

SOIL | GW | SW/SED | AIR | BIO | OTHER

3. USE (CIRCLE ALL THAT APPLY)

SITE CHARAC. (H&S) | RISK ASSESS. | EVAL ALTS. | ENGG DESIGN | PRP DETER. | MONITORING REMEDIAL ACTION | OTHER

4. OBJECTIVE Collect sediment samples at effluent reach to establish vertical gradient of contamination due to groundwater contamination, estimate the risk, and evaluate remediation measures.

5. SITE INFORMATION

AREA Soldier Creek above 15th Avenue
DEPTH TO GROUND WATER
GROUND WATER USE
SOIL TYPES
SENSITIVE RECEPTORS aquatic fauna and human skin contact

6. DATA TYPES (CIRCLE APPROPRIATE DATA TYPES)

A. ANALYTICAL DATA

pH	PESTICIDES	TOX
CONDUCTIVITY	PCB	TOC
VOA	METALS	BTX
ABN	CYANIDE	COD
TCLP		

B. PHYSICAL DATA

PERMEABILITY	HYDRAULIC HEAD
POROSITY	PENETRATION TEST
GRAIN SIZE	HARDNESS
BULK DENSITY	

7. SAMPLING METHOD (CIRCLE METHOD(S) TO BE USED)

ENVIRONMENTAL | BIASED | GRAB | NON- INTRUSIVE | PHASED
SOURCE | GRID | COMPOSITE | INTRUSIVE

8. ANALYTICAL LEVELS (INDICATE LEVEL(S) AND EQUIPMENT & METHODS)

LEVEL 1 FIELD SCREENING - EQUIPMENT
LEVEL 2 FIELD ANALYSIS - EQUIPMENT
LEVEL 3 NON-CLP LABORATORY - METHODS 8260, 8270, 6010, 7421
LEVEL 4 CLP/RAS - METHODS
LEVEL 5 NON STANDARD CEC, TOC, pH

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR
CRITICAL (LIST)
PROCEDURES collect downstream first

10. QUALITY CONTROL SAMPLES (CONFIRM OR SET STANDARD)

A. FIELD
COLLOCATED - 5% OR 10
REPLICATE - 5% OR
FIELD BLANK - 5% OR 5
TRIP BLANK - 1 PER DAY OR 10

B. LABORATORY
REAGENT BLANK - 1 PER ANALYSIS BATCH OR
REPLICATE - 1 PER ANALYSIS BATCH OR
MATRIX SPIKE - 1 PER ANALYSIS BATCH OR
OTHER

11. BUDGET REQUIREMENTS

BUDGET
SCHEDULE February - March 1995
STAFF geologist or hydrologist with one technician

CONTRACTOR Engineering-Science PRIME CONTRACTOR
SITE MANAGER John K. Yu DATE November 1993

FOR DETAILS SEE SAMPLING & ANALYSIS PLAN

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phase contaminants into sediment along areas of Soldier Creek which discharge to groundwater. Therefore, the fractional organic carbon (FOC) or total organic carbon (TOC) in sediments will also be analyzed for, using EPA method 9060 or ASTM D2970. Organic carbon content relates to the retardation factor. Sediment pH also influences the solubility of metals. Cation exchange capacity (CEC), and pH will also be analyzed for by method SW-9080 and SW-9045, respectively. Grain size distribution data is also necessary to determine the percentage of the sediment that may cling to hands and thus be ingested.

5.9.3 Identify Data Quality Needs

Data Quality Factors

Prioritized data uses:	Site characterization Evaluation of alternatives
Appropriate analytical levels:	Site characterization III Evaluation of alternatives III
Contaminants of concern:	Target Compound List (TCL) of compounds and metals (As, Ba, Cd, Cr, Cr^{+3}, Cr^{+6}, Cu, Pb, Hg, Ni, Se, Ag, and Zn
Level of concern:	Reference dose derived concentration and TCLP level
Required detection limits:	EPA CLP equivalent CRDLs
Critical samples:	Two locations of the same formation but at groundwater recharge reaches.

Sediments will be collected at twenty locations, with five samples collected at each location at depths of 0, 1, 2, 3, and 5 feet below ground level. After Task 3 has identified the influent reaches, the twenty sampling locations may be divided among the number of the influent reaches. The length of the reach will be divided by the number of sampling locations to establish grid of equal sampling distances. However, in areas of high variability, e.g., at complex geologic formation and storm sewer or sewage outfalls, the sampling locations may be increased for the effluent reaches identified close to Tinker AFB, but reduced for reaches north of 29th Avenue.

5.9.4 Evaluate Sampling and Analysis Options

At each sampling location, a hand auger will be used to collect sediment samples. Where the streambed cuts into sandstone, a hand held power auger will be used to advance to target depth, then a driving sample will be collected using a split spoon or Environmentalist's Sub-soil Probe (ESP). Soil samples will be shipped to a laboratory for level III analysis using EPA methods.

5.9.5 Review PARCC Parameters

The objective of Task 9 is to determine the presence or absence of contamination due to groundwater discharge into Soldier Creek and to determine the risk to human health and the environment if contamination is present. Task 9

PARCC conditions are the same as for Task 8. The difference between Task 8 and Task 9 is that sediment samples may be collected under water during Task 9 activities, but soil samples collected during Task 8 activities will be collected on dry ground.

SECTION 6

DQO STAGE 3 - DESIGN DATA COLLECTION PROGRAM

Stage 3 of the DQO process is undertaken to integrate the detailed data collection program developed in Stage 2. Stage 3 is required to meet the RI/FS objectives. Figure 6.1 presents the elements necessary to design the data collection program. Through the process of addressing the elements identified in Stages 1 and 2, all the necessary components required for completion of Stage 3 should be available. A phased RI/FS approach has been identified as the appropriate manner in which to collect and evaluate data for SCGW. The development of the work plans and S&A plans must comply with EPA (1990, 1988a) requirements.

6.1 ASSEMBLE DATA COLLECTION COMPONENTS

The intent of Stage 3 is to compile the information and DQOs developed for specific tasks into a comprehensive data collection program. This will allow the site manager and the Tinker AFB RPM to identify field investigation tests which could be undertaken simultaneously and thereby reduce costs associated with the RI/FS.

The data collection program should be developed to account for all sampling tasks and phases. During this process a detailed list of all samples to be obtained should be assembled as well as a schedule for all sampling activities.

6.2 DEVELOP DATA COLLECTION DOCUMENTATION

The result of applying the DQO process is a well defined sampling and analysis plan with summary information provided in the work plan. Quality assurance project plan (QAPP) elements should be included in the Sampling and Analysis Plan (SAP) and the work plan.

6.2.1 Sampling and Analysis Plan

The SAP consists of two parts: (1) a QAPP that describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve DQOs and (2) the field sampling plan (FSP) that provides guidance for all field work by defining in detail the sampling and data-gathering methods to be used.

The SAP components should be written for each of the nine individual tasks. The following information will be provided in the RI:

ASSEMBLE
DATA COLLECTION
COMPONENTS

↓

DEVELOP DATA COLLECTION DOCUMENTATION

- WORK PLAN
- SAMPLING & ANALYSIS PLAN
  Including QAPP & FSP
- HEALTH & SAFETY PLAN
- COMMUNITY RELATIONS PLAN

FIGURE 6.1
STAGE 3 ELEMENTS
DESIGN DATA COLLECTION PROGRAM

- Number of samples to be obtained
- Number of QA/QC samples including field blanks, trip blanks, collocated samples, method blanks, laboratory replicates, and matrix spikes
- Identification of sampling locations and a number system
- Prioritized listing of the sequence in which samples are to be taken from existing wells, etc.
- List of critical samples for each media
- List of analyses which will be performed
- Chain-of-custody for samples transported offsite
- Instrument calibration and maintenance procedures

Details on preparation of the QAPP are contained in *Interim Guidelines and Specification for Preparing QAPPs* (EPA, 1980). The required information should be addressed in the SAP as follows:

- FSP
    1. Site background
    2. Sampling objective
    3. Sample location and frequency
    4. Sample designation
    5. Sampling equipment and procedures
    6. Sample handling and analysis
- QAPP
    1. Project description
    2. Project organization and responsibilities
    3. QA objectives for measurement
    4. Sampling procedures
    5. Sample custody
    6. Calibration procedures
    7. Analytical procedures
    8. Data reduction, validation, and reporting
    9. Internal quality control
    10. Performance and systems audits
    11. Preventative maintenance
    12. Data assessment procedures
    13. Corrective actions

14. Quality assurance reports

6.2.2 Work Plan

Work plans define the scope of services, level of effort, and schedule for performing the RI/FS. The work plan provides a general description of how all tasks and activities will be undertaken. However, it would not contain the detailed description of how each sample is obtained or how the analysis is performed, which is presented in the sampling and analysis plan.

The level of detail in the work plan is outlined below:

- Number of individuals to be involved in each field sampling task and estimated duration in days, including time for mobilization and demobilization.
- Approximate locations of soil and sediment sampling, existing and new wells will be provided, since costs associated with obtaining samples can vary with different sampling locations. Costs for drilling will also vary depending on location.
- List of analyses to be performed
- How data will be validated, compiled and evaluated.

6.2.3 Health and Safety Plan

The health and safety plan (HSP) is required for RI. This HSP will be reviewed by Tinker AFB RPM, EPA RPM, and other regulatory agencies prior to field data collection. It will cover Occupational Safety and Health Administration (OSHA) rule 29 CFR 1910.120 and the EPA (1981) guidance manual *Health and Safety Requirements for Employees Engaged in Field Activities*.

6.2.4 Community Relations Plan

According to the NCP, a community relations plan (CRP) is required for Superfund RI/FSs. For this SCGW RI/FS, the existing Tinker AFB (1990) CRP will be used.

SECTION 7

DQO STAGE 1 - COLLECT AND EVALUATE DATA: RI REPORT AND FS REPORT

The data collection (i.e., actual field investigations) and evaluation steps (DQO Stage 1) take place at the conclusion of Stage 3 of the DQO process (Figure 2.1). In order to simplify the discussion, the elements of Stage 1 will be presented in an abbreviated form. The DQO Stage 1 process must be repeated (usually in an abbreviated form) whenever significant amounts of new data are collected.

As shown in Figure 2.1, the end product of the data collection and evaluation is the RI/FS report. In case another phase is required, the DQO process will be repeated from the Stage 1 RI report to Stages 2 and 3. The DQO process also extends into remedial design and remedial action (RD/RA) to (1) identify data gaps, (2) plan additional sampling activities, (3) collect additional data to design and implement remedy, and (4) monitor the performance for remediation.

SECTION 8

CONCLUSIONS

The use of DQOs required that the uses and needs for each data type be specified at the project outset and be consistent with project objectives. Once data uses were specified, the quality and quantity of data required were determined. The DQO process, incorporated with development of the SAP, QAPP, and WP ensures that data of sufficient quality to meet project objectives were obtained.

The results of applying DQOs appear in cost savings. Sampling costs are reduced by using the conceptual model as a guide in determining the number of samples required. The conceptual model is refined continually as information is gathered during an investigation. Thus, data quantity needs are also continually refined. The use of a sampling methodology which conforms with the conceptual model can significantly reduce the number of samples obtained.

Analytical costs are reduced when DQOs are applied since the chosen analytical method will be the least expensive option which meets all project objectives. An analysis of the possible analytical options together with specified data uses will ensure the appropriate data quality (as defined by the level of analyses) is obtained for each specified data use.

REFERENCES

Battelle, 1993. "Current Northeast Quadrant Investigations," informal letter report, October 22, 1993.

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